

3098

# CERTIFIED-FOR-CONSTRUCTION TECHNICAL SPECIFICATIONS

## ON-SITE DISPOSAL FACILITY PHASE III

United States Department of Energy  
Fernald Environmental Management Project  
Fernald, Ohio

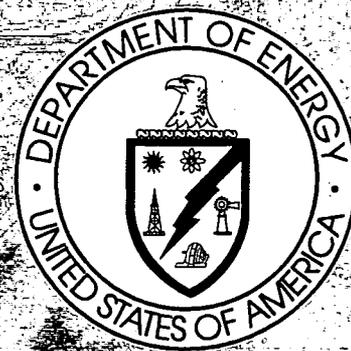
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Contract No. 95PS005028  
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**TECHNICAL SPECIFICATIONS  
ON-SITE DISPOSAL FACILITY OSDF - PHASE III  
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT**

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**SPECIFICATION COVER SHEET**

**SPECIFICATION SECTION:** 02100 **TITLE:** SURVEYING

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**Record of Revision (Number and initial all revisions)**

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**SECTION 02100****SURVEYING****PART 1 GENERAL****1.01 SCOPE**

- A. This Section describes the requirements for surveying, including, but not limited to:
1. establishing temporary survey and control points;
  2. establishing a horizontal and vertical project control system based on existing benchmarks;
  3. setting limits and boundaries of construction activities;
  4. performing support surveys and surveys for conformance checks, "red-line" drawings, and sketches, and to determine measurement of quantities for periodic progress payments and final payment;
  5. preparing and furnishing "red-line" drawings and sketches; and
  6. layout of area isolation trench shown on the Construction Drawings.

**1.02 RELATED SECTIONS AND PLANS**

- A. Section 02110 - Clearing, Grubbing, and Stripping
- B. Section 02200 - Earthwork
- C. Section 02205 - Impacted Material Excavation
- D. Section 02206 - Earthwork for Remediation
- E. Section 02207 - Area Isolation Trenching
- F. Section 02215 - Trenching and Backfilling
- G. Section 02225 - Compacted Clay Liner and Cap
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- J. Section 02250 - Vegetative Soil Layer

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- L. Section 02271 - Riprap
- M. Section 02275 - Erosion and Sediment Control and Surface-Water Management Section
- N. 02280 - Biointrusion Barrier
- O. Section 02605 - High-Density Polyethylene (HDPE) Pipes and Fittings
- P. Section 02710 - Granular Drainage Material
- Q. Section 02712 - Granular Filter Material
- R. Section 02721 - Culverts
- S. Section 02770 - Geomembrane Liner and Cap
- T. Section 02831 - Chain-Link Fences
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- V. Section 13000 - Borrow Area Management
- W. Section 13005 - Liner Penetration Boxes
- X. Section 13010 - Impacted Materials Placement
- Y. Impacted Materials Placement (IMP) Plan
- Z. Part 6 - Statement of Work
- AA. Part 8 - Environmental Health & Safety/Training Requirements
- BB. Part 9 - Quality Assurance Requirements

### 1.03 REFERENCES

- A. National Geodetic Survey (NGS) Standards.

**1.04 QUALIFICATIONS**

- A. Oversight for the survey work shall be provided and certified by a Land Surveyor licensed in the State of Ohio.
- B. Surveying work shall be performed under the direct supervision of a person who has at least 5 years of experience in construction surveying.
- C. Work performed in referencing or re-establishment of land or United States survey monuments shall be signed and sealed by a Land Surveyor licensed in the State of Ohio.

**1.05 SUBMITTALS**

- A. Submit a copy of Land Surveyor's license and a résumé of the person supervising the surveys to the Construction Manager within 10 calendar days from Notice to Proceed.
- B. Submit two copies of the survey notes, sketches, and drawings for the following surveys to the Construction Manager within one week of performance:
  - 1. preliminary surveys;
  - 2. intermediate surveys;
  - 3. written statement and surveys for conformance checks and "red-line" drawings;
  - 4. surveys prior to end of construction season and/or winter shutdown;
  - 5. survey at completion of impacted material excavation specified in Section 02205 of the following:
    - a. above Waste Acceptance Criteria (WAC) material;
    - b. above Final Remedial Level (FRL) material;
    - c. Resource Conservation and Recovery Act (RCRA) hazardous waste;
    - d. underground storage tanks; and
    - e. Hazardous Waste Management Units (HWMUs);
  - 6. survey at completion of the Contract;
  - 7. measurement and payment surveys; and
  - 8. final surveys.
- C. On request by the Construction Manager, submit documentation verifying accuracy of survey work.
- D. Upon completion of the survey work, provide the Construction Manager the original field notes, layout, computations, signed and sealed sketches and drawings in Microstation 95 ".dgn" format or electronic files in other format approved by the Construction Manager.
- E. One complete set of final "red-line" drawings, sketches, and survey notes signed and sealed by a Land Surveyor licensed in the State of Ohio shall be submitted to the

Construction Manager within 15 days of completion of the Contract. Drawing and sketch format shall be Microstation 95 ".dgn" or electronic files in other format approved by the Construction Manager. Survey notes shall include a point listing with coordinates, elevation, and description.

#### **1.06 PROJECT RECORD DOCUMENTS**

- A. Maintain on site, a complete, accurate log documenting survey work as it progresses.
- B. Maintain on-site, a plan showing survey control points, and benchmarks with coordinates and elevations.
- C. Maintain on-site, an accurate and current set of marked-up "red-line" drawings showing "as-built" conditions. "As-built" conditions shall be marked-up on "red-line" drawings within one week of completion of the respective construction activity.

#### **1.07 HEALTH AND SAFETY REQUIREMENTS**

- A. Environmental health & safety/training requirements shall be in accordance with Part 8 of the Contract Documents.

#### **1.08 CONTRACTOR'S QUALITY ASSURANCE**

- A. Contractor's quality assurance requirements shall be in accordance with Part 9 of the Contract Documents.

### **PART 2 PRODUCTS**

#### **2.01 MATERIALS AND SURVEY INSTRUMENTS**

- A. Provide materials as required to properly perform the surveys, including, but not limited to, personal protective equipment, instruments, tapes, rods, measures, mounts and tripods, stakes and hubs, nails, ribbons, other reference markers, and all else as required.
- B. The survey instruments used for this work shall be precise and accurate to meet the needs of the project. Survey instruments should be capable of reading to a precision of 0.001 feet and with a setting accuracy of  $\pm 8$  seconds.

**PART 3 EXECUTION****3.01 GENERAL**

- A. Maintain accurate and complete notes of surveys:
1. Handwritten survey field notes and information shall be documented. A copy of the numbered, dated, and signed documentation shall be given to the Construction Manager weekly or upon request by the Construction Manager. Survey notes shall be legibly recorded. Notation shall be consistently applied to survey work. The stake marking format and the document notations shall be compatible. Identify survey benchmarks on the field notes, sketches, and drawings.
  2. Electronically collected field survey information shall be stored, for retrieval and submittal if requested by the Construction Manager, during the period of performance of the Contract.
    - a. Electronic format for printed output of data collector field survey notes shall be compatible with the approved field notation format.
    - b. Electronic format for printed output of data collector survey work shall be compatible with the Contractor's computer equipment and software specified in this Section for verifying and checking the work. A copy of the data disk shall be submitted to the Construction Manager monthly.
- B. During construction, survey notes shall be retained by the Contractor and Land Surveyor.
- C. Perform surveys for conformance checks specified in this Section. Contractor shall submit a written statement with conformance surveys certifying compliance of the preceding layer thickness, limits, and grades to the Construction Manager.
- D. The precision of horizontal and vertical controls shall meet or exceed Third-Order Class I and Third-Order accuracies, respectively, as defined by NGS Standards.
- E. Conformance check surveys for elevation and for horizontal coordinates shall be recorded to the nearest 0.01 feet and for angles shall be to the nearest 20 seconds.
- F. Measurement and payment surveys for elevation and for horizontal distances shall be recorded to the nearest 0.1 feet and 0.05 feet, respectively.
- G. Final "red-line" drawings and sketches shall be signed and sealed for method and accuracy of work and sealed by the Land Surveyor.
- H. Perform construction layout surveys in advance of scheduled construction activities. At completion of a survey, provide a copy of the field notes, drawings, or sketches to the

Construction Manager for review. The Contractor shall allow the CQC Consultant and/or Construction Manager three working days for review of conformance surveys. The Contractor shall be responsible for rework and/or construction delays caused by survey or staking errors.

- I. Set grade and slope stakes required for construction activities as the work progresses. Staking shall be in accordance with accepted surveying practices, provisions herein, and subject to Construction Manager review. Set fine grade stakes on all surfaces for which the plans show a definite grade line. Grade stakes shall not be permitted on soil layers overlying any geosynthetic material within 12 inches of the geosynthetic material.
- J. Verify pipe alignment and elevation. The Contractor shall:
  1. check layout and elevation of pipe embedment fill prior to pipe placement;
  2. check pipe alignment during placement and backfill; and
  3. verify alignment and elevation at top of pipe after pipe has been backfilled to top of pipe at a maximum interval of 25 feet.
- K. Upon completion of the work, the Contractor shall provide the Construction Manager with original survey field notes, layouts, computations, and electronic files, binders containing electronic file information and one copy each of electronic files specified in this Section.
- L. Protect benchmarks and survey control points. Replace disturbed survey control points and benchmarks at no additional cost.
- M. Establish temporary survey control points to support construction work activities.
- N. Survey control points, accuracy, and documentation:
  1. Record the following information in survey notebooks for each control point established:
    - a. designation of control point;
    - b. coordinates based on State Planar North American Datum (NAD) 1983 Ohio South;
    - c. elevations based on National Geodetic Vertical Datum (NGVD);
    - d. date of establishment;
    - e. description and sketch of the control point location; and
    - f. control points referenced to a minimum of three features that can be seen from the control point.
  2. Document survey work in the fieldbooks using the format and procedures described below:
    - a. title and consecutive fieldbook number on the front cover;
    - b. consecutively numbered pages;
    - c. table of contents, indicated by survey task, on the first numbered page;

- d. legend indicating symbols used in survey notes;
- e. names of survey team for each task;
- f. notes on weather, equipment, etc.;
- g. date and time on each page to indicate when work was recorded;
- h. notes in a uniform character such that they can be interpreted and used by anyone with survey knowledge; and
- i. description and/or sketches of the existing survey control used.

### 3.02 SUPPORT SURVEYS

#### A. Preliminary Surveys:

1. Verification of the Existing Conditions:
  - a. Prior to the start of clearing and earthwork activities, verify the accuracy of the existing conditions shown on the Construction Drawings and Reference Drawings. Immediately notify the Construction Manager in writing of deviations from the existing conditions indicated on the Construction Drawings and Reference Drawings that affect construction cost and/or schedule.
2. Verify the existing benchmarks, structures, utilities, wells, topography, surface-water management and erosion control measures, construction safety and radiological-control fences, sedimentation basins and appurtenances, drainage features, and existing stockpiles of materials and quantities shown on the Construction Drawings, Reference Drawings, or specified in the Contract. Notify the Construction Manager of any differences or conflicts with work included in this Contract.
3. Verify Mid-Valley Pipeline Easement as shown on the Construction Drawings adjacent to battery limits. Stake western limits of easement at 50-foot intervals.
4. Establish construction limits required for installation of the construction safety fence and radiological-control fence specified in Section 02200.
5. Establish location for the installation of the surface-water management and erosion control measures specified in Sections 02270, 02271, and 02275.
6. Clearing Limit Staking: Stake clearing limits specified in Section 02110.
7. Alignment and Existing Ground Staking: Following clearing operations and before stripping operations begin, preliminary locations of alignments and/or baseline of project features shall be established. Perform topographic surveys to describe original ground features before stripping or excavation begins. The distance between grid points shall not exceed 50 feet, and all breaks shall be noted.
8. Earthwork Staking: Staking for excavation and fill limits shall establish the exterior limits of excavations and fills. The maximum staking interval shall be 50 feet. Stakes shall be prominently noted with description of point, vertical distance to design elevation, and offset distance as applicable.

9. Perform additional surveys required for the layout of other construction activities.
10. Prior to construction activities in remedial excavation areas specified in Sections 02205 and 02207, perform topographic surveys of Stockpile-7 (SP-7) debris, staging areas, excavation areas, and concrete crushing support areas at minimum 50-foot intervals with additional points as follows:
  - a. grade breaks;
  - b. points of horizontal curvature and tangency;
  - c. edge and corners of concrete or asphalt pads, slabs, catch basins, and manholes;
  - d. above-grade obstructions (e.g., fire hydrants, utility poles, handrails, etc.); and
  - e. ditches, channels, and depressions.In addition, spot check slab elevations as indicated on applicable building foundation reference drawings. This includes basement, pit, sump, and other below-grade slab elevations.
11. Prior to area isolation trench excavation specified in Section 02207, survey the trench location and stake the center line of the trenches.
12. Initial limits of excavation specified in Section 02207 shall be surveyed and staked after the completion of excavation of area isolation trenches.

**B. Intermediate Surveys:**

1. Perform surveys during progress of the construction activities to verify the accuracy of work and as directed by the Construction Manager. These surveys include, but are not limited to, surveys of the subgrade excavation; compacted clay liner and cap; Leak Detection System (LDS), Leachate Collection System (LCS), and cover drainage layers; protective layer; contouring layer; biointrusion barrier layer; granular filter; vegetative soil layer; topsoil; LDS and LCS piping; horizontal monitoring wells; select impacted material layer; impacted material layer; and other surveys directed by the Construction Manager.
2. Perform surveys for the impacted material placement and stockpiles as follows:
  - a. Survey the locations and surface of impacted material placement when the category of impacted material changes in any given grid. Survey the locations and surface of the previous layers prior to changing impacted material category within the grid.
  - b. Survey the impacted material placed in the OSDF every week and within one working day of the last day of the month. This survey shall include locations, elevations, category of impacted materials, and pertinent information in ASCII format necessary to develop a 3-D topographic computer generated surface.
  - c. Perform interim surveys of impacted material stockpiles or other areas designated by the Construction Manager. This survey shall include volume (CY) remaining in the stockpiles or in designated areas.

- d. Survey the impacted material surface in the OSDF, including the cell access ramps, at the completion of the construction season activities.
  - 3. Perform surveys for measurement and periodic progress payment as specified in this Section.
  - 4. Perform surveys during progress of impacted material excavations specified in Section 02205 to confirm limits of the excavation.
  - 5. Perform survey if either the Great Miami Aquifer (GMA) is encountered or excavation has reached the GMA elevation as indicated on the Construction Drawings.
  - 6. Perform surveys after the installation of the first 2 feet of GMA plug placement to confirm 2 feet thickness.
  - 7. Perform surveys at the completion of GMA plug placement (5-feet+ thick).
  - 8. Perform surveys at the completion of the 3A/4A Tank Farm Settling Basin, including:
    - a. half section of 24-inch diameter reinforced concrete pipe (RCP);
    - b. precast concrete basin;
    - c. 18-inch diameter corrugated metal pipe (CMP); and
    - d. discharge elevation into Catch Basin CB-86.
  - 9. Perform survey when establishing new Special Material Transfer Areas or Debris Staging Areas.
  - 10. Prior to obtaining clay fill material for constructing GMA plug, perform topographic survey and establish work limits of designated borrow areas.
  - 11. Perform survey at the completion of each supplemental excavation.
- C. Final Surveys:
- 1. Final topography shall be surveyed at nominal 50-foot intervals. Additionally, the following points shall be surveyed as applicable:
    - a. grade breaks;
    - b. points of horizontal curvature and tangency; and
    - c. points of stationing equation.
  - 2. Structures: Survey structure centerlines or building lines so that the orientation, position, limits, and foundation elevation(s) are positively identified.
  - 3. Ditches and Channels: Survey ditches, channels, and culverts as specified in Sections 02270 and 02721.
  - 4. Limits of Final Excavations: Survey limits of final impacted material excavations.

### 3.03 SURVEYS FOR MEASUREMENT AND PAYMENT

- A. Perform surveys for periodic progress payments and final payment to determine quantities of work and percent of completed work. Quantities to be measured and measurements for quantities shall be as specified in Part 6 of the Contract Documents.

- B. Calculate and certify quantities of work and submit survey notes and calculations to the Construction Manager for review, evaluation, and payment.

### **3.04 SURVEYS FOR CONFORMANCE CHECKS AND “ RED-LINE” DOCUMENTS**

- A. Survey the following to verify the locations, lines, and grades achieved during construction for conformance checks and “red-line” documents:
  - 1. for berms, roads, ditches, and other earthwork specified in Sections 02200, 02206, 02230, and 02270:
    - a. original grade surface;
    - b. compacted surface of cut slopes; and
    - c. finished grade surface;
  - 2. for culverts and other surface-water management and erosion control structures specified in Sections 02270 and 02721:
    - a. original grade surface;
    - b. pipe inverts; and
    - c. finished grade surface;
  - 3. for the subgrade specified in Section 02200:
    - a. prepared subgrade surface;
  - 4. for the trenching and backfilling specified in Section 02215;
    - a. bottom of the liner system anchor trench and pipe trench and top of finished compacted backfill; and
    - b. pipes and culverts;
  - 5. for the compacted clay liner specified in Section 02225:
    - a. finished compacted clay liner surface;
  - 6. for the liner penetration boxes specified in Section 13005 and shown on the Construction Drawings:
    - a. original grade surface; and
    - b. top of liner penetration boxes;
  - 7. for the LDS, LCS, and cover drainage layers, and piping specified in Sections 02605 and 02710:
    - a. finished grade surface;
    - b. horizontal monitoring wells; and
    - c. piping system, including location of each joint;
  - 8. for the granular filter specified in Section 02712:
    - a. finished granular filter surface;
  - 9. for the compacted clay cap specified in Section 02225:
    - a. prepared top of non-impacted contouring layer surface; and
    - b. finished compacted clay cap surface;
  - 10. for the geomembrane liner and cap specified in Section 02770:
    - a. anchor trench;

- b. top and bottom of side slopes;
  - c. seam intersections;
  - d. repairs; and
  - e. location of destructive testing;
11. for the non-impacted protective layer specified in Section 02240:
    - a. finished protective layer surface;
  12. for impacted material placement surface specified in Section 13010:
    - a. top of protective layer surface;
    - b. top of select impacted material layers (liner and final cover system) surfaces;
    - c. top of final impacted material surface (prior to placement of select impacted material layer in final cover system); and
    - d. Category 5 material placement per specialized placement plans as specified in the IMP Plan.
  13. for biointrusion barrier specified in Section 02280:
    - a. finished biointrusion barrier surface;
  14. for vegetative soil layer specified in Section 02250:
    - a. finished vegetative soil layer surface;
  15. for topsoil specified in Section 02920:
    - a. top of topsoil surface;
  16. for chain-link fences specified in Section 02831:
    - a. location and alignment;
  17. for the borrow area specified in Section 13000:
    - a. test pits used for pre-conformance testing; and
    - b. finished grades of interim restoration of borrow subareas;
  18. for 3A/4A Tank Farm Settling Basin specified in Section 02205:
    - a. finished grade surface at southern wall spillway to confirm that spillway is level; and
  19. centerlines, point of intersections, and bottom elevation of area isolation trenches specified in Section 02207.
- B. Drawings and sketches for the items described in this Section shall include the following:
1. North arrow, graphical scale, title block, and legend;
  2. Northing and Easting grid lines;
  3. spot grade location and elevation on plan including list of coordinates with point number, northing, easting, and elevation in table format;
  4. 1-foot contour lines;
  5. location of structures;
  6. labeled components;
  7. for geomembrane liner and cap plans:
    - a. all seams;
    - b. panel identification numbers;

- c. location of top of slope, toe of slope, anchor trench, and limits of geomembrane;
  - d. repair location and identifying number; and
  - e. destructive testing location and identifying number; and
8. for pipe profiles:
- a. original grades with stationing;
  - b. final grades with stationing; and
  - c. pipe with inverts, slopes, pipe material, pipe size, and length of pipe.
- C. Perform conformance checks and “red-line” surveying immediately upon completion of a given installation or excavation activity to facilitate progress and avoid delaying commencement of the next installation. Provide the following minimum spacings and locations for survey points (additional survey points may be required if field conditions warrant):
1. surfaces with gradients less than 10 percent, survey on a square grid spaced not wider than 50 feet;
  2. on slopes greater than 10 percent, a square grid spaced not wider than 50 feet shall be used, but in any case, a line at the crest and toe of the slope shall be taken; if the slope distance is greater than 50 feet, a midpoint slope survey point is required;
  3. a line of survey points spaced not more than 50 feet apart shall be taken along any slope break (this will include the inside edge and outside edge of any bench on a slope);
  4. a line of survey points spaced not more than 25 feet apart shall be taken at the top of any pipes or other appurtenances;
  5. at the corners and midpoints of the top and bottom of slope breaks for liner penetration areas in cells; and
  6. along the southern wall spillway of the 3A/4A Tank Farm Settling Basin, survey points not more than 25-feet apart.

[END OF SECTION]

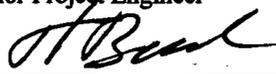
**SPECIFICATION COVER SHEET**

**SPECIFICATION SECTION:** 02110 **TITLE:** CLEARING, GRUBBING, AND STRIPPING

**Specifications By:** (Cognizant Engineer) Signature  Date 5 May 00  
Printed Name Michael J. Monteleone, P.E.  
and Title Senior Project Engineer

**Scope and Format**  
**Checked By:** (Checker) Signature  Date 5 May 00  
Printed Name Michael J. Monteleone, P.E.  
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**Detailed Requirements**  
**Checked by:** (Checker) Signature  Date 5 May 2000  
Printed Name Kwasi Badu-Tweneboah, Ph.D., P.E.  
and Title Senior Project Engineer

**Overall Review By:** (PDP) Signature  Date 8 May 2000  
Printed Name J.F. Beech, Ph.D., P.E.  
and Title Principal

**Approved by:** (DTL) Signature  Date 8 May 2000  
Printed Name J.F. Beech, Ph.D., P.E.  
and Title Principal

**Record of Revision (Number and initial all revisions)**

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**SECTION 02110**

**CLEARING, GRUBBING, AND STRIPPING**

**PART 1 GENERAL**

**1.01 SCOPE**

- A. This Section includes clearing, grubbing, and stripping.

**1.02 RELATED SECTIONS AND PLANS**

- A. Section 02100 - Surveying
- B. Section 02200 - Earthwork
- C. Section 02270 - Surface-Water Management and Erosion Control
- D. Section 02930 - Vegetation
- E. Part 6 - Statement of Work
- F. Part 8 - Environmental Health & Safety/Training Requirements
- G. Part 9 - Quality Assurance Requirements

**1.03 DEFINITIONS**

- A. Clearing consists of the removal of trees, bushes, vegetation, and other surface debris that are 18 inches above the ground surface.
- B. Grubbing consists of the removal of stumps, roots, and vegetation to a depth of 3 feet below the existing ground surface or subgrade elevation, whichever is lower.
- C. Stripping consists of the removal of minimum 6 inches topsoil layer including roots and organic matter, grass, and other material unsuitable for use as subgrade or compacted fill.

**1.04 SUBMITTALS**

- A. Provide list of equipment, description of construction methods, and other required information to perform clearing, grubbing, and stripping with the Contractor's Earthwork Work Plan specified in Section 02200.

**1.05 HEALTH AND SAFETY REQUIREMENTS**

- A. Environmental health & safety/training requirements shall be in accordance with Part 8 of the Contract Documents.

**1.06 CONTRACTOR'S QUALITY ASSURANCE**

- A. Contractor's quality assurance requirements shall be in accordance with Part 9 of the Contract Documents.

**PART 2 PRODUCTS**

**2.01 MATERIALS**

Not used.

**2.02 EQUIPMENT**

- A. Furnish equipment to perform the clearing, grubbing, and stripping specified in this Section.

**PART 3 EXECUTION**

**3.01 GENERAL**

- A. Dust control measures for clearing, grubbing, and stripping activities shall be in accordance with Part 6 of the Contract Documents.

**3.02 SURFACE-WATER MANAGEMENT AND EROSION CONTROL**

- A. Prior to performing clearing, grubbing, and/or stripping, install surface-water management and erosion controls specified in Section 02270.

**3.03 CLEARING AND GRUBBING**

- A. Perform clearing and grubbing in excavation, compacted fill, trenching, road construction, fencing, and stockpiling areas as indicated on the Construction Drawings unless otherwise directed by the Construction Manager.
- B. Perform clearing and grubbing as separate activities.
- C. In those areas where only clearing is required, perform clearing in a manner that minimizes disturbance to the existing ground surface.
- D. Chip cleared materials of a woody nature to a size that is suitable for use as mulch. Keep cleared material to be chipped as free of soil and other inorganic matter as possible. Cleared material smaller than 3 inches in maximum dimension need not be chipped.
- E. Stockpile cleared and grubbed materials separately in the stockpile areas shown on the Construction Drawings or as directed by the Construction Manager. Stockpiling of cleared and grubbed materials shall be in accordance with Section 02200.
- F. After completion of grubbing, fill and compact depressions outside the grading limits. Material type and degree of compaction shall meet the requirements specified for compacted fill in Section 02200. Match fill elevation to the surrounding grade and grade to drain.

**3.04 STRIPPING**

- A. Perform stripping in excavation, compacted fill, trenching, road construction, and stockpiling areas as indicated on the Construction Drawings. Transport stripped material to the stockpile areas shown on the Construction Drawings or as directed by the Construction Manager. Stockpiling of stripped material shall be in accordance with Section 02200.
- B. If soil or weather conditions are unsuitable for stripping, due to precipitation or high wind as determined by the Construction Manager, cease stripping activities until permission to resume stripping activities is obtained from the Construction Manager.

**3.05 SURVEY CONTROL**

- A. Survey the limits of clearing in accordance with Section 02100.

[END OF SECTION]

**SPECIFICATION COVER SHEET**

**SPECIFICATION SECTION:** 02200 **TITLE:** EARTHWORK

**Specifications By:** (Cognizant Engineer)  
 Signature [Signature] Date 5 May 00  
 Printed Name Michael J. Monteleone, P.E.  
 and Title Senior Project Engineer

**Scope and Format**  
**Checked By:** (Checker)  
 Signature [Signature] Date 5 May 00  
 Printed Name Michael J. Monteleone, P.E.  
 and Title Senior Project Engineer

**Detailed Requirements**  
**Checked by:** (Checker)  
 Signature [Signature] Date 5 May 2000  
 Printed Name Kwasi Badu-Tweneboah, Ph.D., P.E.  
 and Title Senior Project Engineer

**Overall Review By:** (PDP)  
 Signature [Signature] Date 8 May 2000  
 Printed Name J.F. Beech, Ph.D., P.E.  
 and Title Principal

**Approved by:** (DTL)  
 Signature [Signature] Date 8 May 2000  
 Printed Name J.F. Beech, Ph.D., P.E.  
 and Title Principal

**Record of Revision (Number and initial all revisions)**

Rev. No.	Reason	Date	By	Checked	Approval
0	Certified for Construction	08 May 00		KBT	JF

**SECTION 02200****EARTHWORK****PART 1 GENERAL****1.01 SCOPE**

- A. This Section includes site preparation including construction safety fence and radiological-control fence, surface-water management and erosion control, excavation, dewatering, stockpiling, subgrade and top of contouring layer preparation, compacted fill, and clayey rockfill.

**1.02 RELATED SECTIONS AND PLANS**

- A. Section 02100 - Surveying
- B. Section 02110 - Clearing, Grubbing, and Stripping
- C. Section 02150 - Traffic Control
- D. Section 02205 - Impacted Material Excavation
- E. Section 02215 - Trenching and Backfilling
- F. Section 02225 - Compacted Clay Liner and Cap
- G. Section 02230 - Road Construction
- H. Section 02240 - Non-Impacted Protective and Contouring Layers
- I. Section 02250 - Vegetative Soil Layer
- J. Section 02270 - Surface-Water Management and Erosion Control
- K. Section 02271 - Riprap
- L. Section 02280 - Biointrusion Barrier
- M. Section 02605 - High-Density Polyethylene (HDPE) Pipes and Fittings
- N. Section 02710 - Granular Drainage Material

- O. Section 02712 - Granular Filter Material
- P. Section 02714 - Geotextiles
- Q. Section 02721 - Culverts
- R. Section 02831 - Chain-Link Fences
- S. Section 02920 - Topsoil
- T. Section 02930 - Vegetation
- U. Section 13000 - Borrow Area Management
- V. Section 13005 - Liner Penetration Boxes
- W. Section 13010 - Impacted Materials Placement
- X. Construction Quality Assurance (CQA) Plan
- Y. Part 6 - Statement of Work
- Z. Part 8 - Environmental Health & Safety/Training Requirements
- AA. Part 9 - Quality Assurance Requirements

### 1.03 REFERENCES

- A. Latest version of American Society for Testing and Materials (ASTM) Standards:
  - 1. ASTM D 698. Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft<sup>3</sup> (600 kN-m/m<sup>3</sup>)).
  - 2. ASTM D 2487. Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System).
- B. Reference Reports addressing On-Site Disposal Facility (OSDF) and borrow area site subsurface conditions:
  - 1. "Geotechnical Investigation Report, On-Site Disposal Facility" [Parsons, 1995]. This report contains geotechnical data for the subsurface soils in the OSDF area.
  - 2. "Disposal Facility Pre-Design Geotechnical Investigation, Soil Investigation Data Report, CERCLA-RCRA Unit 2" [Science Applications International Corporation, 1995]. This report presents geotechnical data for the subsurface soils in the OSDF area.

3. "Geotechnical Data and Evaluation Report for East and South Field Borrow Areas" [Parsons, 1996]. This report contains geotechnical data for the subsurface soils in the borrow area.

#### 1.04 SUBMITTALS

- A. Submit to the Construction Manager for review a Contractor's Earthwork Work Plan within 30 calendar days from Notice to Proceed. The Contractor's Earthwork Work Plan shall include, at a minimum:
  1. list of equipment and description of construction methods proposed for the scope specified in this Section and in Sections 02110, 02215, 02225, 02230, 02240, 02250, 02271, 02280, 02605, 02710, 02712, 02714, 02721, 02831, 02920, 02930, and 13005;
  2. location of equipment service area and fueling station;
  3. excavation and trenching dewatering methods and techniques;
  4. methods for removal of visible rock particles larger than specified from the material for compacted fill and clayey rockfill specified in this Section and compacted clay liner and cap specified in Section 02225;
  5. coordination of survey requirements for the site work;
  6. verification of the existing conditions and material stockpiles;
  7. stockpile management plan including surface-water management and erosion control, stockpiling by type of material, stockpile maintenance, stockpile removal and relocation, and site grading and stabilization;
  8. coordination of earthwork activities with Contractor's Surface-Water Management and Erosion Control Work Plan specified in Section 02270;
  9. schedule for site work activities;
  10. water supply system including location, type, and size of water tank, water distribution system and equipment for dust control, construction and wheel wash system;
  11. plan and measures for cold weather at temperatures below 32 degrees Fahrenheit site work activities;
  12. installation and maintenance of construction safety fence and radiological-control fence;
  13. coordination with Traffic Control Plan specified in Section 02150;
  14. location of construction laydown area(s);
  15. locations of stockpiles for material generated from clearing, grubbing, and stripping operations;
  16. layout and typical cross sections of roads within the Contractor's work area;
  17. construction site access and haul road layout;
  18. construction utilities layout including construction power and water;
  19. description of methods for installation and removal of trench supports; and

20. coordination with the Contractor's Quality Assurance Work Plan in accordance with Part 9 of the Contract Documents.

### **1.05 HEALTH AND SAFETY REQUIREMENTS**

- A. Environmental health & safety/training requirements shall be in accordance with Part 8 of the Contract Documents.

### **1.06 CONTRACTOR'S QUALITY ASSURANCE**

- A. Contractor's quality assurance requirements shall be in accordance with Part 9 of the Contract Documents.

## **PART 2 PRODUCTS**

### **2.01 MATERIALS**

- A. Obtain fill material for compacted fill from OSDF cell excavation, trenching, and stockpiles shown on the Construction Drawings. Obtain additional fill material for compacted fill, if required, from the on-site borrow area indicated on the Construction Drawings. Borrow area management shall be in accordance with Section 13000.
- B. Fill material for compacted fill and trench backfill shall be free of debris, foreign objects, large rock fragments, organics, and other deleterious materials. Visible rock particles shall be maximum dimension of 5 inches for 8-inch  $\pm$ 1-inch thick loose lifts and 2 inches for 4-inch  $\pm$ 1-inch thick loose lifts. Material for compacted fill shall conform to GC, SC, SM, ML, CL, or CH according to the Unified Soil Classification System (per ASTM D 2487).
- C. Clayey rockfill: The reject material from clay screening operations may be substituted for material for compacted fill below base aggregate elevations in the impacted material haul roads, cell access ramps, access corridor located outside the perimeter berm baseline, and borrow area haul road; for interim restoration in borrow area; and other fill areas outside the OSDF perimeter berm baseline. Use of clayey rockfill as specified in this Section shall be approved by the Construction Manager.
- D. Construction water for moisture conditioning compacted fill shall be obtained from the on-site water source shown on the Construction Drawings.
- E. Construction safety fence and radiological-control fence for activities with duration less than 30 calendar days shall be orange, high-density polyethylene, 4 feet in height, opening size approximately 4 inches by 1 inch, minimum tensile strength of 2000

pounds per foot of width. Where used to delineate radiologically controlled areas (RCAs), the color shall be yellow. Posts shall be T-shaped (T-post), 1-1/2 inch by 1-1/2 inch, 3/16 inch thick by 6 feet long, and made of steel or as approved by the Construction Manager.

- F. Furnish construction safety fence and radiological-control fence for activities with a duration greater than 30 calendar days made of galvanized steel welded wire fabric, 2 inch by 4 inch mesh, 4 feet in height, 12-1/2 gauge, or equivalent approved by the Construction Manager. Posts for the fence material shall be 6 feet long and made of steel. Install posts at spacing recommended by the Manufacturer's installation procedures and as required to prevent sagging.

G. Contractor shall furnish and install signs for construction safety fence in accordance with Part 8 of the Contract Documents.

- H. Signs for radiological-control fence shall be furnished and installed by Fluor Fernald, Inc.

## 2.02 EQUIPMENT

- A. Furnish equipment to perform work specified in this Section.
- B. Furnish equipment to achieve required compaction specified in this Section.
- C. Furnish hand compaction equipment, such as walk-behind padfoot compactors, hand tampers, or vibratory plate compactors, for compaction in areas inaccessible to large compaction equipment.
- D. Furnish water tank trucks, pressure distributors, or other equipment designed to apply water uniformly and in controlled quantities at variable surface widths to provide the required in-place moisture content and to prevent drying of soil surfaces.
- E. Furnish equipment such as scarifiers, disks, spring tooth or spike tooth harrows, earth hauling equipment, and other equipment as required for earthwork construction.

## PART 3 EXECUTION

### 3.01 GENERAL

- A. Verify existing conditions in accordance with Section 02100.
- B. Perform construction activities in such a manner that equipment operating in the RCAs do not operate in non-RCAs. Equipment operating in RCAs shall be washed by the

Contractor; and radiologically surveyed and released by Fluor Fernald, Inc. prior to exiting for use in non-RCAs.

- C. Install surface-water management and erosion controls in accordance with Section 02270.
- D. Dust control shall be in accordance with Part 6 of the Contract Documents.

### **3.02 SITE PREPARATION**

- A. Install construction safety fence and radiological-control fence at construction limits and limits of the RCAs in accordance with the Contractor's Earthwork Work Plan and Part 8 of the Contract Documents. Relocate construction safety fence and radiological-control fence as shown on the Construction Drawings or as approved by the Construction Manager. Provide construction safety fence as shown on Construction Drawings. Signs and barricades around trenches, stockpiles, and excavated areas shall be in accordance with Part 8 of the Contract Documents.
- B. Maintain and repair construction safety fence and radiological-control fence for the duration of the Contract. Fencing shall be maintained so as to minimize vertical sagging.
- C. Install, maintain, and inspect surface-water management and erosion controls in accordance with Section 02270.
- D. Prior to earthwork activities, perform clearing, grubbing, and stripping in accordance with Section 02110.
- E. Construct impacted material haul roads, cell access ramps, and access corridors in accordance with the Construction Drawings and Section 02230.
- F. Locate existing manholes, drop inlet structures, monitoring wells, piezometers, lysimeters, utilities, and other subsurface structures in the work area. Protect structures and utilities during earthwork activities as indicated on the Construction Drawings.

### **3.03 SURFACE-WATER MANAGEMENT AND EROSION CONTROL**

- A. Install surface-water management and erosion controls in and around work areas in accordance with Section 02270.

### **3.04 EXCAVATION**

- A. Excavate designated areas to the subgrade elevations or excavation limits shown on the Construction Drawings. Stockpile excavated material in the designated stockpile area

shown on the Construction Drawings or at locations approved by the Construction Manager.

- B. Excavate material within the excavation limits, including rock encountered, regardless of type, character, composition, and condition. Remove clay pipe tile subdrain system when encountered in accordance with Section 02205. Place clay pipe subdrain section in the OSDF constructed cells in accordance with Section 13010.
- C. Blasting, including use of explosives or explosive devices, shall not be permitted.
- D. Remove and relocate impacted material encountered during excavation in accordance with Section 02205. Impacted material meeting OSDF Waste Acceptance Criteria (WAC) shall be placed in accordance with Section 13010. Impacted materials exceeding OSDF WAC shall be disposed of in accordance with Section 02205.
- E. Minimize sloughing and caving of excavations. Over-excavate and fill areas of excavations that cave or slough with compacted fill in accordance with this Section.
- F. Over-excavate abandoned monitoring wells, borings, utilities, and lysimeters within the OSDF perimeter baseline shown on the Reference Drawings to a depth of 3 feet below subgrade elevation. Well casings, concrete, and grout shall be excavated in accordance with Section 02205 and placed in the OSDF constructed cells in accordance with Section 13010. Before removal of the existing well casings, Construction Managers will verify closure of the existing wells. Fill to subgrade elevation with compacted fill in accordance with this Section.
- G. Do not remove soil from the site or dispose of soil included in this Contract except as approved in writing by the Construction Manager.
- H. Perform activities in such a manner that hauling equipment transporting non-impacted materials do not operate on roads used to haul impacted material. Equipment driven on roads used to haul impacted material or in an impacted area shall be washed by Contractor, and radiologically surveyed and released by Fluor Fernald, Inc. prior to being used for earthwork activities in non-impacted areas.
- I. Perform activities in such a manner that earthwork and hauling equipment working in contamination areas do not cross into certified areas.
- J. Remove the existing North Entrance Road pavement within the limits shown on the Construction Drawings and haul and place in OSDF constructed cells in accordance with Section 13010. Existing North Entrance Road pavement section consists of 6 inches of asphaltic concrete over 6 inches of crushed rock. Excavate 2 feet below bottom of pavement elevation and road shoulder in accordance with Section 02205 and

place in accordance with Section 13010, unless otherwise directed by the Construction Manager.

- K. Stabilize disturbed areas in accordance with Section 02930.

### **3.05 EXCAVATION DEWATERING**

- A. Anticipate seepage of groundwater into and accumulation of surface-water runoff in excavations. Manage groundwater and surface-water runoff in excavations in accordance with this Section and Section 02270.
- B. Collect water that accumulates in the excavation in a toe drain, or other suitable sump, and pump to the former production area stormwater drain control system, the leachate transmission system, or other locations as directed by the Construction Manager.
- C. Prevent surface-water runoff from adjacent areas from entering the excavation in accordance with Section 02270.

### **3.06 STOCKPILING**

- A. Stockpile excavated soils in the stockpile areas shown on the Construction Drawings or as directed by the Construction Manager.
- B. Construct stockpiles no steeper than 3H:1V (horizontal:vertical), grade to drain, seal by tracking perpendicular to the slope contours with a dozer, and dress daily during periods when material is taken from or added to the stockpile.
- C. Install surface-water management and erosion control measures at the stockpile areas in accordance with Section 02270. Stabilize stockpiles in accordance with Section 02930.

### **3.07 SUBGRADE AND TOP OF CONTOURING LAYER PREPARATION**

- A. Subgrade and top of contouring layer material shall be free of debris, foreign objects, organics, and other deleterious materials.
- B. In the event saturated subgrade is encountered, localized sumps shall be constructed to facilitate removal of water. Manage removed water in accordance with this Section.
- C. Perform subgrade and top of contouring layer proofrolling by driving a loaded dump truck with minimum loaded weight of 20 tons and minimum weight of 10 tons per axle or other pneumatic-tired vehicle back and forth across the area to be prepared to confirm the firmness of subgrade and top of contouring layer surface. Overlap the passes such that one set of tires on each pass runs between the two sets of tire tracks from the previous pass. Soils shall not exhibit pumping or develop ruts more than 2

inches in depth. Rutting, larger than 2 inches, shall be scarified in accordance with this Section and regraded with compacted fill material or non-impacted contouring layer material to meet the proposed subgrade or top of contouring layer elevations.

- D. Subgrade for the compacted clay liner and top of contouring layer shall be scarified in accordance with Section 02225. At other locations where compacted fill is to be placed, prepare the subgrade by scarifying to a depth of 2 inches using the equipment identified in this Section.
- E. In areas where unsuitable soils are encountered, remove and replace the soil to a minimum depth of 1 foot below the proposed subgrade elevation. Remove unsuitable subgrade to an additional depth if necessary to obtain a suitable soil surface for subsequent fill placement. Removal of unsuitable soils to additional depth shall be as approved by the Construction Manager. Suitable soil surface exhibiting pumping or developing ruts more than 2 inches in depth shall be removed to a minimum depth of 1 foot or dried in place by a method approved by the Construction Manager. Fill areas from which subgrade has been removed with compacted fill in accordance with this Section. Compact the fill material to at least 95 percent standard Proctor maximum dry unit weight as determined by ASTM D 698. Compact the uppermost lift of compacted fill beneath road and access corridor alignments to a minimum 98 percent of the standard Proctor maximum dry unit weight as determined by ASTM D 698.
- F. In excavations or other areas where water accumulates, implement measures to remove the water in accordance with this Section. Maintain the subgrade surface free of standing water and in a firm condition to meet the proofrolling requirements of this Section. Maintain dewatered areas in this condition until overlying construction is complete.
- G. Manage surface-water runoff or runoff in accordance with Section 02270.

### 3.08 COMPACTED FILL

- A. Use fill material that meets the material requirements of this Section. Place the fill material to the limits and grades shown on the Construction Drawings.
- B. Place fill material on surfaces which are free of debris, branches, vegetation, mud, ice, or other deleterious materials.
- C. Place fill material in loose lifts with a thickness of 8 inches  $\pm$  1 inch. In areas where compaction is to be performed using hand-operated equipment, place the fill material in loose lifts with a thickness of 4 inches  $\pm$  1 inch.

- D. Remove visible rock particles with a maximum dimension larger than 5 inches for 8-inch  $\pm$ 1-inch thick loose lifts. For 4-inch  $\pm$ 1-inch thick loose lifts, the maximum rock particle size shall be 2 inches.
- E. Prior to placing a succeeding lift of fill material over a previously compacted lift, thoroughly scarify the previous lift to a depth of 2 inches by discing, raking, or tracking with a dozer. Moisture condition the preceding lift in accordance with this Section if the moisture content of the surface of the preceding lift is not within the range of acceptable moisture contents specified in this Section.
- F. The trafficking of scarified surfaces by trucks or other equipment, except compaction equipment, is not permitted.
- G. The maximum acceptable soil clod size after processing is 3 inches. Reduce clod size by discing, raking, tracking with a dozer, using a soil stabilizer, or other means approved by the Construction Manager. Soil clumps, consisting of an agglomeration of 3-inch clods, or smaller, will not be considered a clod for purposes of this Section.
- H. Compact fill material in each lift to at least 95 percent of its standard Proctor maximum dry unit weight as determined by ASTM D 698. Compact fill at a moisture content within  $\pm$ 3 percentage points of the standard Proctor optimum moisture content as determined by ASTM D 698.
- I. Moisture condition the fill material to achieve the compaction requirements of this Section. Use a water spraying system for wetting. During wetting or drying, regularly disc, rake, or otherwise mix the material to thoroughly blend the moisture throughout the lift. Use discing, raking, or other appropriate methods to dry the material as required.
- J. Do not place frozen fill nor place fill material on frozen subgrade or previously placed compacted fill.
- K. Do not compact fill material at temperatures below 32 degrees Fahrenheit, unless authorized in writing by the Construction Manager.
- L. Do not place fill during periods of precipitation. Placement may occur during periods of misting or drizzle, but only if authorized by the Construction Manager.
- M. Rework compacted fill that does not meet the required compaction.

**3.09 CLAYEY ROCKFILL**

- A. Visible rock particles with maximum dimension greater than 12 inches shall be removed from the clayey rockfill and stockpiled for future use in areas designated by the Construction Manager. Clayey rockfill shall be placed in maximum 12-inch thick loose lifts and compacted with a minimum of four passes of a Caterpillar 815 compactor or approved equal. Final lift surface of compacted clayey rockfill material shall be proofrolled as specified in this Section. Any compacted clayey rockfill material exhibiting excessive pumping or rutting (ruts greater than 2 inches in depth) due to wet material or insufficient compaction shall be dried and recompactd or removed from the fill. Clayey rockfill shall be used only as specified in this Section unless otherwise approved by the Construction Manager.

**3.10 PERFORATIONS**

- A. Perforations in the compacted fill, subgrade, and top of contouring layer resulting from survey stakes or other activities shall be backfilled with soil-bentonite mix specified in Section 02225. Perforations resulting from nuclear density tests and sand-cone or drive cylinder density tests will be filled by the CQC Consultant in accordance with Section 02225.

**3.11 CONSTRUCTION QUALITY REQUIREMENTS**

- A. CQC Consultant will perform soil conformance testing on compacted fill materials to confirm compliance with this Section. Conformance testing to be performed and minimum testing frequencies shall be in accordance with the Construction Quality Assurance (CQA) Plan. Provide equipment and labor to assist the CQC Consultant in obtaining conformance samples from excavations, stockpiles, and borrow areas. Identify source(s) and quantity of fill material required from each source for Construction Manager's approval at least 15 calendar days prior to use.
- B. CQC Consultant will monitor earthwork activities in accordance with this Section and the CQA Plan. CQC Consultant will provide documentation to the Construction Manager for the proofrolling of subgrade, top of contouring layer, and compacted clayey rockfill final lift surface.
- C. CQC Consultant will perform performance testing on compacted fill lifts to confirm compliance with this Section. The performance testing to be performed and minimum testing frequencies shall be in accordance with the CQA Plan.
- D. If CQC Consultant's tests indicate that any portion of the compacted fill does not meet the requirements of this Section, CQC Consultant will delineate the extent of the

nonconforming area. Rework the nonconforming area until it meets the requirements of this Section.

### 3.12 SURVEY CONTROL

- A. Survey the locations, limits and grades of excavations, stockpiles, prepared subgrade, compacted fill, and compacted clayey rockfill in accordance with Section 02100.

### 3.13 TOLERANCES

- A. Perform the earthwork construction to within  $\pm 0.3$  feet of the grades indicated on the Construction Drawings except for subgrade for the compacted clay liner, top of contouring layer, access corridor, and roads for which earthwork construction shall be within  $-0.3$  to  $+0.1$  feet of the grades indicated.

[END OF SECTION]

**SPECIFICATION COVER SHEET**

**SPECIFICATION SECTION:** 02215 **TITLE:** TRENCHING AND BACKFILLING

**Specifications By:** (Cognizant Engineer)  
 Signature [Signature] Date 5 May 00  
 Printed Name Michael J. Monteleone, P.E.  
 and Title Senior Project Engineer

**Scope and Format**  
**Checked By:** (Checker)  
 Signature [Signature] Date 5 May 00  
 Printed Name Michael J. Monteleone, P.E.  
 and Title Senior Project Engineer

**Detailed Requirements**  
**Checked by:** (Checker)  
 Signature [Signature] Date 5 May 2000  
 Printed Name Kwasi Badu-Tweneboah, Ph.D., P.E.  
 and Title Senior Project Engineer

**Overall Review By:** (PDP)  
 Signature [Signature] Date 8 May 2000  
 Printed Name J.F. Beech, Ph.D., P.E.  
 and Title Principal

**Approved by:** (DTL)  
 Signature [Signature] Date 8 May 2000  
 Printed Name J.F. Beech, Ph.D., P.E.  
 and Title Principal

**Record of Revision (Number and initial all revisions)**

Rev. No.	Reason	Date	By	Checked	Approval
0	Certified for Construction	08 May 00		EBT	JB

**SECTION 02215****TRENCHING AND BACKFILLING****PART 1 GENERAL****1.01 SCOPE**

- A. This Section includes trenching and backfilling, including pipe embedment fill materials and placement.

**1.02 RELATED SECTIONS AND PLANS**

- A. Section 02100 - Surveying
- B. Section 02110 - Clearing, Grubbing, and Stripping
- C. Section 02200 - Earthwork
- D. Section 02225 - Compacted Clay Liner and Cap
- E. Section 02605 - High-Density Polyethylene (HDPE) Pipes and Fittings
- F. Section 02721 - Culverts
- G. Section 13000 - Borrow Area Management
- H. Construction Quality Assurance (CQA) Plan
- I. Part 6 - Statement of Work
- J. Part 8 - Environmental Health & Safety/Training Requirements
- K. Part 9 - Quality Assurance Requirements

**1.03 REFERENCES**

- A. Latest version of American Society for Testing and Materials (ASTM) Standards:
1. ASTM C 136. Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
  2. ASTM D 698. Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft<sup>3</sup> (600 kN-m/m<sup>3</sup>)).

- B. Latest version of Ohio Department of Transportation Construction and Material Specifications (Ohio DOT Specifications).
- C. Latest version of Occupational Safety and Health Administration (OSHA) Construction Standards.
- D. Reference Reports addressing On-Site Disposal Facility (OSDF) and borrow area site subsurface conditions and off-site borrow sources:
  - 1. "Geotechnical Investigation Report, On-Site Disposal Facility" [Parsons, 1995]. This report contains geotechnical data for the subsurface soils in the OSDF area.
  - 2. "Disposal Facility Pre-Design Geotechnical Investigation, Soil Investigation Data Report, CERCLA-RCRA Unit 2" [Science Applications International Corporation, 1995]. This report presents geotechnical data for the subsurface soils in the OSDF area.
  - 3. "Geotechnical Data and Evaluation Report for East and South Field Borrow Areas" [Parsons, 1996]. This report contains geotechnical data for the subsurface soils in the borrow area.
  - 4. "Off-Site Borrow Materials Geotechnical Evaluation Report" [Parsons, 1996]. This report presents geotechnical data for potential off-site borrow sources for OSDF construction materials, including fine concrete aggregates (sand), coarse concrete aggregates (gravel), pea gravel, and riprap.

#### 1.04 SUBMITTALS

- A. For each source of pipe embedment fill material, submit the following to the Construction Manager for review within 30 calendar days from Notice to Proceed:
  - 1. the source of the pipe embedment fill material;
  - 2. written certification and test results conducted in accordance with ASTM C 136; and
  - 3. a 50-pound representative sample of the pipe embedment fill for visual examination, and testing, if necessary.
- B. Provide a list of equipment, description of construction methods for trenching and backfilling, and other required information for trenching and backfilling in the Contractor's Earthwork Work Plan specified in Section 02200.

#### 1.05 HEALTH AND SAFETY REQUIREMENTS

- A. Environmental health & safety/training requirements shall be in accordance with Part 8 of the Contract Documents.

**1.06 CONTRACTOR'S QUALITY ASSURANCE**

- A. Contractor's quality assurance requirements shall be in accordance with Part 9 of the Contract Documents.

**PART 2 PRODUCTS****2.01 MATERIALS**

- A. Furnish natural sand pipe embedment fill material for reinforced concrete pipe (RCP), corrugated metal pipe (CMP), and high-density polyethylene (HDPE) pipe meeting the gradation requirements of Section 703.06 of the Ohio DOT Specifications unless otherwise indicated on the Construction Drawings or specified in this Section. Gradation testing shall be in accordance with ASTM C 136.
- B. Furnish trench backfill material for RCP, CMP, HDPE pipe, and electrical conduit that meet the fill material requirements for compacted fill specified in Section 02200. Obtain trench backfill material from OSDF cell excavation, trenching, and stockpiles shown on the Construction Drawings. Obtain additional material for trench backfill, if required, from on-site borrow areas indicated on the Construction Drawings. Borrow area management shall be in accordance with Section 13000.
- C. Trench backfill material for liner system anchor trenches shall meet the material requirements for compacted clay liner and cap specified in Section 02225.
- D. Construction water for moisture conditioning trench backfill shall be obtained from on-site water source shown on the Construction Drawings.
- E. Furnish a minimum 4-inch wide plastic underground marker tape with suitable warning legend to mark HDPE pipes and electrical conduits.
- F. Furnish 14-gauge insulated stranded copper wire as shown on the Construction Drawings.

**2.02 EQUIPMENT**

- A. Furnish equipment to perform the work specified in this Section.
- B. Furnish hand compaction equipment such as walk-behind pad-foot compactor, hand tamper, or vibratory plate compactors for compaction in areas inaccessible to large compaction equipment.

## **PART 3 EXECUTION**

### **3.01 GENERAL**

- A. Verify existing conditions in accordance with Section 02100.
- B. Review existing site utility drawings, and identify and stake existing above and below ground utilities in vicinity of trenching. Staking shall be as approved by the Construction Manager.
- C. In areas of trenching and backfilling, maintain and protect existing above and below ground utilities.
- D. Do not damage or disturb survey benchmarks, finished construction, and existing utilities and structures.
- E. Perform clearing, grubbing, and stripping in accordance with Section 02110.
- F. Dust control for trenching and backfilling shall be in accordance with Part 6 of the Contract Documents.

### **3.02 TRENCHING**

- A. Trench for placement of pipes and for liner system anchor trenches shall be to the depths and dimensions shown on the Construction Drawings. Stockpile excess excavated material from trenching in the stockpile areas shown on the Construction Drawings in accordance with Section 02200.
- B. Use trench support methods approved by the Construction Manager. Trench support shall satisfy applicable local, state, and federal requirements, including requirements of the OSHA Construction Standards. Provide trench support materials on site prior to the start of trenching. Maintain the safety and stability of slopes and trenches and protect adjacent utilities and structures.
- C. Protect and maintain the trench bottom. Remove rock fragments or raveled materials that collect on the trench bottom. Backfill any overexcavation with compacted fill in accordance with Section 02200. Excavate any soft subgrade encountered at the trench bottom and backfill to trench bottom elevation with compacted fill in accordance with Section 02200.

- D. Where trenches will be excavated in compacted fill areas, perform trenching only after compacted fill has reached at least 12 inches above top of the pipe.
- E. Limit the maximum length of open trench to 200 feet in advance and 200 feet behind pipe installation unless otherwise approved by the Construction Manager. Contractor shall provide appropriate non-skid surface walkways, such as wooden boards, for access across liner system anchor trenches.
- F. Continuously dewater trenches. Perform dewatering in accordance with Section 02200.
- G. The inside edge of liner system anchor trenches where geosynthetics will be placed shall be cut with a trenching machine to minimize soil raveling and shall be rounded to a minimum 6-inch radius.

### 3.03 BACKFILLING

- A. General:
  - 1. Do not backfill with frozen or saturated material.
  - 2. Do not backfill over frozen, wet, or soft trench bottom or side slopes. Remove materials that are frozen, wet, or soft as specified in this Section.
  - 3. Do not disturb or damage piping or geosynthetics in trench during backfilling.
  - 4. Do not use compaction equipment which exerts greater than 10 pounds per square inch ground pressure over piping that is covered by less than 12 inches of backfill material.
- B. Placement of pipe embedment fill for pipes and culverts:
  - 1. Place pipe embedment fill in 7-inch  $\pm$ 1-inch thick loose lifts to the elevation of the bottom of the pipe or culvert.
  - 2. Compact pipe embedment fill with a minimum of 4 passes of a vibratory plate compactor prior to placing pipe.
  - 3. Place pipe or culvert on top of the compacted pipe embedment fill.
  - 4. Install 14-gauge insulated stranded copper wire to top of HDPE pipes as shown on the Construction Drawings. Use cable tie-wraps at 5-foot intervals to tie copper wire to pipe prior to backfilling.
  - 5. For pipes 12 inches in diameter or less, place additional pipe embedment fill on the sides and gently hand tamp the fill around the sides as needed, such that intimate contact between the pipe and the pipe embedment fill is maintained below the spring line of the pipe. Continue placing pipe embedment fill until it is even with the top of the pipe. Compact the pipe embedment fill with a minimum of 4 passes of a walk-behind pad-foot compactor, hand tamper, or vibratory plate compactor, as appropriate. Place pipe embedment fill above the top of pipe to a minimum depth of 12 inches in two 7-inch  $\pm$ 1-inch thick loose lifts. Compact

- each lift of pipe embedment fill with a minimum of 4 passes of a walk-behind pad-foot compactor, hand tamper, or vibratory plate compactor, as appropriate.
6. For pipes or culverts greater than 12 inches in diameter, place pipe embedment fill in 7-inch  $\pm$ 1-inch thick loose lifts to the limits shown on the Construction Drawings. Compact each lift with a minimum of 4 passes of a vibratory plate compactor.
- C. Placement of trench backfill material for pipes and culverts:
1. After placement and compaction of pipe embedment fill to the limits shown on the Construction Drawings, place the first lift of trench backfill material in a 12-inch thick loose lift. Place subsequent lifts of trench backfill material in 8-inch  $\pm$ 1-inch thick loose lifts.
  2. Compact trench backfill material in each lift to at least 95 percent of its standard Proctor maximum dry unit weight and at a moisture content within  $\pm$ 3 percent of the optimum moisture content as determined by ASTM D 698.
- D. Placement of trench backfill material for liner system anchor trench:
1. Place the anchor trench backfill material in 8-inch  $\pm$ 1-inch thick loose lifts if compaction equipment operating weight is greater than 2000 pounds, and in 4-inch  $\pm$ 1-inch thick loose lifts if compaction equipment operating weight is less than 2000 pounds.
  2. Compact the anchor trench backfill material to the minimum dry unit weight and range of moisture contents required for compacted clay liner and cap material specified in Section 02225.
- E. Place underground marker tape in trench backfill 12 inches below finished grade above all HDPE pipes and electrical conduits.

### **3.04 PERFORATIONS**

- A. Perforations in the trench backfill resulting from survey stakes or other activities shall be backfilled with trench backfill material. Perforations resulting from nuclear density tests and sand-cone or drive cylinder density tests will be filled with trench backfill material by the CQC Consultant.

### **3.05 CONSTRUCTION QUALITY REQUIREMENTS**

- A. CQC Consultant will perform conformance testing on pipe embedment fill and trench backfill materials to establish compliance with this Section, and Sections 02200 and 02225, as applicable. The conformance testing to be performed and the minimum testing frequencies shall be in accordance with the Construction Quality Assurance (CQA) Plan.

- B. CQC Consultant will monitor trenching and backfilling as specified in this Section and the CQA Plan.
- C. CQC Consultant will perform performance testing on the backfill materials to establish compliance with this Section. The performance testing to be performed and minimum testing frequencies shall be in accordance with the CQA Plan.

### **3.06 SURVEY CONTROL**

- A. Survey the locations, limits, and grades of the bottom of the liner system anchor trench and compacted trench backfill in accordance with Section 02100.
- B. Survey the locations, limits, and grades of pipes and culverts in accordance with Section 02100.

### **3.07 TOLERANCES**

- A. Trench bottom shall be within 0 to +0.2 feet of the depth indicated on the Construction Drawings.
- B. Embedment fill for pipes and culverts shall be placed within 0 to +0.2 feet of the depth indicated on the Construction Drawings.

[END OF SECTION]

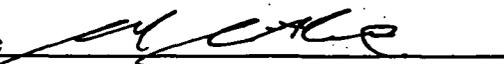
**SPECIFICATION COVER SHEET**

**SPECIFICATION SECTION:** 02225 **TITLE:** COMPACTED CLAY LINER AND CAP

**Specifications By:** Signature  5 May 00  
 (Cognizant Engineer) Date

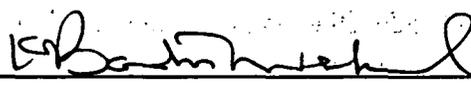
Printed Name Michael J. Monteleone, P.E.  
and Title Senior Project Engineer

**Scope and Format**

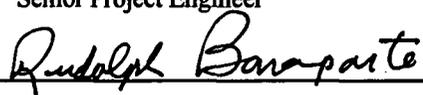
**Checked By:** Signature  5 May 00  
 (Checker) Date

Printed Name Michael J. Monteleone, P.E.  
and Title Senior Project Engineer

**Detailed Requirements**

**Checked by:** Signature  5 May 2000  
 (Checker) Date

Printed Name Kwasi Badu-Tweneboah, Ph.D., P.E.  
and Title Senior Project Engineer

**Overall Review By:** Signature  7 May 2000  
 (PDP) Date

Printed Name Rudolph Bonaparte, Ph.D., P.E.  
and Title Principal

**Approved by:** Signature  8 May 2000  
 (DTL) Date

Printed Name J.F. Beech, Ph.D., P.E.  
and Title Principal

**Record of Revision (Number and initial all revisions)**

Rev. No.	Reason	Date	By	Checked	Approval
0	Certified for Construction	08 May 00		KBT	JFB

**SECTION 02225****COMPACTED CLAY LINER AND CAP****PART 1 GENERAL****1.01 SCOPE**

- A. This Section includes excavating, segregating and stockpiling non-conforming and pre-conforming soils based on results from the pre-conformance testing, screening and stockpiling pre-conforming soils, segregating clay liner and cap material stockpiles based on results from conformance testing, and moisture conditioning, loading, hauling, placing, and compacting clay liner and cap material, including protective clay layer.
- B. Quantity of stockpiled clay liner and cap material to be furnished by Fluor Fernald, Inc. will be as specified in Part 6 of the Contract Documents. Additional clay material required for compacted clay liner and cap construction shall be screened and stockpiled by the Contractor.

**1.02 RELATED SECTIONS AND PLANS**

- A. Section 02100 - Surveying
- B. Section 02150 - Traffic Control
- C. Section 02200 - Earthwork
- D. Section 02240 - Non-Impacted Protective and Contouring Layers
- E. Section 02772 - Geosynthetic Clay Liner and Cap
- F. Section 02930 - Vegetation
- G. Section 13000 - Borrow Area Management
- H. Construction Quality Assurance (CQA) Plan
- I. Part 6 - Statement of Work
- J. Part 8 - Environmental Health & Safety/Training Requirements
- K. Part 9 - Quality Assurance Requirements

### 1.03 REFERENCES

- A. Latest version of American Society for Testing and Materials (ASTM) Standards:
1. ASTM D 422. Standard Test Method for Particle-Size Analysis of Soils.
  2. ASTM D 698. Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft<sup>3</sup> (600 kN-m/m<sup>3</sup>)).
  3. ASTM D 1557. Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft<sup>3</sup> (2,700 kN-m/m<sup>3</sup>)).
  4. ASTM D 2487. Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System).
  5. ASTM D 2488. Standard Practice for Description and Identification of Soils (Visual-Manual Procedure).
  6. ASTM D 4318. Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
  7. ASTM D 5084. Standard Test Method for Measurement of Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter.
  8. ASTM E 946. Standard Test Method for Water Absorption of Bentonite by the Porous Plate Method
- B. Reference Reports addressing On-Site Disposal Facility (OSDF) and borrow area site subsurface conditions:
1. *"Geotechnical Investigation Report, On-Site Disposal Facility"* [Parsons, 1995]. This report contains geotechnical data for the subsurface soils in the OSDF area.
  2. *"Disposal Facility Pre-Design Geotechnical Investigation, Soil Investigation Data Report, CERCLA/RCRA Unit 2"* [Science Applications International, 1995]. This report presents geotechnical data for the subsurface soils in the OSDF area.
  3. *"Geotechnical Data and Evaluation Report for East and South Field Borrow Areas"* [Parsons, 1996]. This report contains geotechnical data for the subsurface soils in the borrow area.
- C. *"Test Pad Program Final Report, On-Site Disposal Facility"*, Volumes I-III [GeoSyntec, 1997]. This report contains information on the development of the placement and compaction requirements for the compacted clay liner and cap.
- D. *"Test Pad Program Final Report Addendum No. 1, On-Site Disposal Facility"* [GeoSyntec, 1999]. This report addendum provides modification to the acceptable permeability zone (APZ) for the compacted clay liner and cap.

**1.04 SUBMITTALS**

- A. Provide a list of equipment, description of methods, and other required information for compacted clay liner and cap construction, as specified in this Section, in the Contractor's Earthwork Work Plan specified in Section 02200. The components of the Contractor's Earthwork Work Plan specified in this Section shall be integrated with the Contractor's Borrow Area Management and Restoration Work Plan specified in Section 13000. If alternative equipment is proposed, provide a detailed demonstration that the proposed equipment is in all aspects functionally equivalent to the equipment specified in this Section. The description of methods and equipment shall include, but is not limited to:
1. equipment and methods for obtaining soil samples for the pre-conformance testing;
  2. equipment and methods for excavating, segregating, and stockpiling non-conforming and pre-conforming soils from borrow area excavation and after screening;
  3. mechanical screening plant and other equipment and methods to remove rock with a maximum dimension larger than 2 inches and equipment and methods for moisture conditioning of screened clay material;
  4. equipment and methods for management of various stockpiles, including moisture conditioning and stabilization of stockpiles; stabilization shall be as specified in Section 02930; management of stockpiles shall also include methods to measure, monitor, segregate, and delineate screened clay material stockpiles;
  5. equipment and methods to load and haul screened clay liner and cap material from the clay liner and cap material stockpiles to the OSDF;
  6. equipment and methods to scarify, place, spread, moisture condition, clay liner and cap material in the OSDF; and
  7. repair procedure for compacted clay liner and cap.
- B. In the Contractor's Traffic Control Work Plan specified in Section 02150, show haul road for hauling clay liner and cap material from screened clay material stockpiles to the OSDF.
- C. Submit to the Construction Manager for review within 30 calendar days from Notice to Proceed, a specification sheet for the proposed bentonite powder or granules and provide a 5-pound representative sample of the material.

**1.05 HEALTH AND SAFETY REQUIREMENTS**

- A. Environmental health & safety/training requirements shall be in accordance with Part 8 of the Contract Documents.

## 1.06 CONTRACTOR'S QUALITY ASSURANCE

- A. Contractor's quality assurance requirements shall be in accordance with Part 9 of the Contract Documents.

## PART 2 PRODUCTS

### 2.01 MATERIALS

- A. Material for compacted clay liner and cap construction, including protective clay layer, shall be obtained from the OSDF excavation included in this Contract and borrow area excavations indicated on the Construction Drawings. Segregate and stockpile non-conforming and pre-conforming soils from the excavations and screen only those materials identified through pre-conformance testing as meeting the material requirements of this Section, with the exception of hydraulic conductivity. Minor granular lenses that when readily mixed with surrounding soil result in a material that meets the material requirements of this Section need not be segregated. Pre-conforming and non-conforming soils to be used for other construction shall be in accordance with Section 13000.
- B. Borrow area management shall be in accordance with Section 13000.
- C. Materials conforming to pre-conformance testing criteria shall be screened prior to conformance testing. Screened clay material meeting the clay liner and cap material requirements specified in this Section shall be referred to as clay liner and cap material and shall be used for compacted clay liner and cap construction, including protective clay layer.
- D. Clay liner and cap material shall meet the following requirements:
1. be classified according to the Unified Soil Classification System (ASTM D 2487) as lean clay (CL) or fat clay (CH);
  2. have a plasticity index (ASTM D 4318) of at least 10 percent, but less than 40 percent;
  3. meet the following particle size requirements (ASTM D 422):
    - a. 100 percent of the particles having a maximum dimension not greater than 2 inches;
    - b. not more than 10 percent of the particles, by weight, having a dimension greater than 0.75 inches;
    - c. not less than 50 percent of the particles, by weight, passing through the standard U.S. No. 200 standard sieve; and
    - d. not less than 15 percent of the particles, by weight, having a maximum dimension not greater than 0.002 mm; and

4. have a hydraulic conductivity of not more than  $1 \times 10^{-7}$  centimeter per second (cm/s) when constructed in accordance with this Section and when tested in the laboratory in accordance with ASTM D 5084 at a confining pressure of 5 pounds per square inch (psi).
- E. Construction water for moisture conditioning clay liner and cap material shall be obtained from the on-site water source shown on the Construction Drawings.
- F. Bentonite granules shall contain at least 85 percent sodium montmorillonite and a water adsorption of at least 500 percent when tested in accordance with ASTM E 946.
- G. Soil-bentonite mix for backfilling perforations shall consist of a minimum of 10 percent by weight bentonite granules mixed with clay liner and cap material (by dry weight basis).

## 2.02 EQUIPMENT

- A. Equipment for excavation shall be as specified in Section 02200. Provide equipment required to obtain soil samples for the preformance testing, screen, stockpile, load, haul, spread, place, moisture condition, scarify and compact clay liner and cap material as specified in this Section and indicated on the Construction Drawings.
- B. Use mechanical screening plant with self-contained power to remove rock particles having a maximum dimension larger than 2 inches. Moisture condition the screened material during screening and after stockpiling. Capacity of the screening plant shall meet or exceed the clay liner and cap material placement rate to support the construction schedule specified in Part 6 of the Contract Document. Electric power for screening equipment will not be available.
- C. Use hauling and placing equipment to place clay liner and cap material in uniform loose lift thicknesses as specified in this Section.
- D. Use tank trucks, pressure distributors, soil stabilizers, or other equipment designed to apply water uniformly and in controlled quantities to moisture condition clay liner and cap material and to prevent drying of soil surfaces.
- E. Use grading equipment to achieve uniform layers, sections, and smoothness of grade for compaction and drainage.
- F. Use the following soil stabilizer for processing clay liner and cap material:
  1. Caterpillar SS250 soil stabilizer with water spray bar; or
  2. HAMM RACO 250 or 550 soil stabilizer with water spray bar ; or
  3. approved equal.

- G. Use the following soil compaction equipment for compacting clay liner and cap material:
  - 1. Caterpillar 815; or
  - 2. approved equal.
- H. Use hand compaction equipment such as a walk-behind pad-foot compactor or hand tamper to obtain required compaction in areas inaccessible to large compaction equipment.
- I. Use the following equipment for sealing the compacted clay liner and cap lift surfaces and for compacting the first lift of the protective clay layer:
  - 1. Caterpillar CS563; or
  - 2. equivalent self-propelled smooth drum roller approved by the Construction Manager.

### **PART 3 EXECUTION**

#### **3.01 GENERAL**

- A. Perform construction activities in such a manner that equipment operating in radiologically controlled areas (RCAs) does not operate in non-RCAs. Equipment operating in RCAs shall be washed and radiologically surveyed and released by Fluor Fernald, Inc. prior to exiting for use in non-RCAs.
- B. Dust control measures shall be in accordance with Part 6 of the Contract Documents.
- C. Assist the CQC Consultant in obtaining soil samples for pre-conformance testing.
- D. Excavate the materials identified by the pre-conformance test results as a source for clay liner and cap material from the OSDF and borrow area as specified in Section 02200. Segregate pre-conforming and non-conforming soils and stockpile in areas shown on the Construction Drawings. Stabilize stockpiles as specified in Section 02930.
- E. Continuously remove visible rock particles having a maximum dimension larger than 2 inches during material placement, stabilization, and compaction.
- F. Moisture condition the clay liner and cap material stockpiles including existing and screened clay material stockpile produced under this Contract. Provide water as required to moisture condition the screened material.

**3.02 MATERIAL SCREENING AND STOCKPILING**

- A. Locate mechanical screening plant(s) for removal of rock from pre-conforming soils in the borrow area outside the subarea to be excavated in accordance with the Contractor's Borrow Area Management and Restoration Work Plan.
- B. After installation and setup of the mechanical screening plant(s) is complete, notify Construction Manager for safety inspection. Do not operate screening plant(s) prior to completion of the Construction Manager safety inspection.
- C. Stockpile screened material in approximately 5,000 to 10,000 cubic yard stockpiles for clay liner and cap conformance testing and confirmation of compliance with this Section. The clay material shall be moisture conditioned to within approximately 2 percentage points of the optimum moisture content prior to stockpiling. Maintain stockpile moisture condition by sealing, wetting, drying, and/or discing, as necessary. Delineate and identify each screened clay material stockpile. Notify Construction Manager when each stockpile is ready for conformance testing using signs provided by Fluor Fernald, Inc. and sign posts furnished by Contractor. Construction Manager will notify the Contractor of approval of the clay liner and cap material for placement 15 calendar days from the date that a stockpile is ready for conformance testing. Stabilize clay liner and cap material with crusting agent as specified in Section 02930.
- D. Clayey rockfill spoil from screening (i.e., clumps or clods mixed with rock particles) may be rescreened.
- E. Stockpile clayey rockfill, as defined in Section 02200, from screening at stockpile area shown on the Construction Drawings. Stabilize stockpiles in accordance with Section 02930.

**3.03 COMPACTED CLAY LINER AND CAP PERFORMANCE CRITERIA**

- A. The moisture content and dry unit weight of clay liner and cap material placed shall be within the acceptable permeability zone (APZ) defined as those combinations of moisture content and dry unit weight that meet the following three criteria: (i) moisture content that is on or to the right (in the direction of increasing moisture content) of the line of optimums determined by connecting the optimum moisture contents from the standard and modified Proctor compaction tests (ASTM D 698 and ASTM D 1557, respectively); (ii) moisture content not greater than 3 percentage points wet of the standard Proctor optimum moisture content (ASTM D 698); and (iii) dry unit weight of at least 95 percent of the standard Proctor maximum dry unit weight (ASTM D 698). The Construction Manager will provide Contractor with specific moisture content

ranges and associated dry unit weights that satisfy these criteria for each approved clay liner and cap material stockpile.

### **3.04 MATERIAL PLACEMENT**

- A. Place clay liner and cap material only after completion of the following activities:**
  - 1. conformance testing and written confirmation of compliance of clay liner and cap material by CQC Consultant;**
  - 2. performance testing and written confirmation of compliance of underlying layers, including acceptance of Contractor's survey results by CQC Consultant; and**
  - 3. written approval of the clay liner and cap material stockpile by the Construction Manager.**
  
- B. Prepare subgrade and top of contouring layer in accordance with Sections 02200 and survey in accordance with Section 02100 prior to scarification. Scarify the surface on which the first lift of clay liner and cap material is to be placed to a depth of 2 inches using the stabilizer. In the event the stabilizer cannot operate on the cell or contouring layer slopes, scarify by using a disc, tracking back and forth with a bulldozer, or a combination of both. Moisture content for the scarified subgrade or contouring layer shall be 0 to +3 percent of the standard Proctor optimum moisture content as determined by ASTM D 698.**
  
- C. Prior to placement of clay liner and cap material, ensure that the surface on which the clay liner and cap material is to be placed is free of debris, vegetation, mud, ice, and other deleterious material.**
  
- D. Construct compacted clay liner and cap to the grades and minimum thicknesses shown on the Construction Drawings. The thickness of the compacted clay liner and cap at any location shall be measured perpendicular to the plane of the slope at that location.**
  
- E. Remove visible rock particles with a maximum dimension larger than 2 inches from the clay liner and cap material during placement, spreading, stabilizing, compaction, grading, and sealing of the compacted clay liner and cap. Place rock particles removed from the clay liner and cap material in a stockpile in an area approved by the Construction Manager.**
  
- F. In areas where compaction is to be performed using the Caterpillar 815, or equivalent equipment, place the clay liner and cap material in loose lifts with a thickness of 7 inches  $\pm$  1 inch, except for the first lift over the subgrade or contouring layer. The first lift shall be 10 inches  $\pm$  1 inch thick. In areas where compaction is to be performed using hand-operated equipment, place the clay liner and cap material in loose lifts with**

a loose lift thickness of 4 inches  $\pm$ 1 inch. Loose lift thicknesses shall be measured after spreading but before processing with the soil stabilizer.

- G. Do not place a succeeding lift of clay liner and cap material over any area until the CQC Consultant has completed performance testing of the compacted lift in that area.
- H. Prior to compacting a succeeding lift of material over a previous lift, scarify the previous lift to a depth of 2 inches using the soil stabilizer. Scarification may occur either before or after placement of the succeeding lift. In either case, set the stabilizer mix depth appropriately to achieve the required depth of scarification. Moisture condition the succeeding lift in accordance with this Section. In the event the stabilizer cannot operate on the cell slopes, scarify each preceding lift prior to placing the next lift by using a disc, tracking back and forth with a bulldozer, or a combination of both.
- I. Limit the trafficking of scarified surfaces by trucks or other equipment, except stabilizer, moisture conditioning, and compaction equipment.
- J. The maximum acceptable soil clod size after processing with the soil stabilizer shall be 3 inches or half the lift thickness, whichever is smaller. Reduce clod size using the soil stabilizer. Soil clumps, consisting of an agglomeration of smaller clods, will not be considered a clod for purposes of this Section. After making each pass of the soil stabilizer, remove visible rock particles with a maximum dimension larger than 2 inches. A minimum of one pass of the soil stabilizer shall be required.
- K. Moisture condition the loose lift of clay liner and cap material prior to compaction if necessary. Distribute the moisture through the loose lift using the soil stabilizer. Moisture condition, if necessary, as follows:
  - 1. If the clay liner and cap material is drier than required, process the material with the soil stabilizer to obtain a uniform consistency, distribute water uniformly into the soil to achieve the required moisture content, then process the material again with the soil stabilizer to obtain uniform mixing. The CQC Consultant will check the moisture content of the soil at the completion of these three steps and/or after compaction. Repeat the latter two steps if the measured moisture content is not within the acceptable range specified in this Section.
  - 2. If the clay liner and cap material is wetter than required, dry the material by processing with the soil stabilizer. The CQC Consultant will check the moisture content of the soil at the completion of processing or compaction. Repeat the processing if the measured moisture content is not within the acceptable range specified in this Section.
  - 3. After making each pass of the soil stabilizer, remove visible rock particles with a maximum dimension larger than 2 inches.

- L. In the event the soil stabilizer cannot operate on cell slopes, process and moisture condition the clay material at the base of the slope in accordance with this Section. After completion of processing and moisture conditioning, use a bulldozer to place the clay liner and cap material on the slope in loose lifts with a maximum thickness of 8 inches. After placement of the clay liner and cap material on the slope, remove visible rock particles with a maximum dimension larger than 2 inches.
- M. Do not place frozen clay liner and cap material nor place clay liner and cap material on frozen ground.
- N. Do not place clay liner and cap material at temperatures below 32 degrees Fahrenheit (32°F), unless otherwise authorized in writing by the Construction Manager. If cold weather (less than 32°F) clay liner and cap material placement and/or compaction is to be implemented, prepare and submit a written plan as part of the Contractor's Earthwork Work Plan specified in Section 02200, describing proposed cold weather placement and compaction procedures and the weather parameters for which cold weather operations are proposed. Include protection of work in accordance with the requirements of this Section.
- O. If clay liner and cap material freezes after compaction, remove the frozen material, scarify the remaining unfrozen material, and replace material and compact in accordance with this Section. Do not reuse the frozen material until it has thawed and has been reprocessed to the specified moisture content. Include the protective measures to be taken for placement, compaction, and protection of clay liner and cap material under construction during freezing conditions in the Contractor's Earthwork Work Plan specified in Section 02200. Protective measures may include the use of thermal blankets or a sacrificial soil layer.
- P. Do not place clay liner and cap material during periods of precipitation. Placement may occur during periods of misting or drizzle, but only if approved by the Construction Manager.
- Q. Prepare the last lift of the compacted clay liner or cap to meet the minimum thicknesses and grades indicated on the Construction Drawings. Meet the construction tolerance requirements specified in this Section.

### 3.05 MATERIAL COMPACTION

- A. Compact loose lifts using a minimum of six passes of the specified compaction equipment. Provide additional passes to achieve performance criteria specified in this Section.

- B. For a dual-drum compactor with laterally-separated front and rear drums, a compaction pass is defined as one trip up and a staggered trip back to cover the uncompacted area between the drums (i.e., one full coverage).
- C. Compact corners, around pipes, around liner penetration boxes, and other areas inaccessible to Caterpillar 815, or approved equal, compaction equipment using hand operated equipment approved by the Construction Manager to achieve performance criteria specified in this Section.
- D. Maintain surface of compacted clay liner and cap in moist condition to avoid crusting and desiccation. In the event crusting or desiccation occurs, protect the compacted clay liner and cap in accordance with this Section.
- E. Construct the transition from an existing full-depth section of compacted clay liner or cap to the beginning of an adjacent section that is to be constructed subsequently by sloping (cutting back) the end of the full-depth section at 5:1 (horizontal:vertical) or flatter, scarifying the slope of the existing full-depth section at the transition, and then immediately begin constructing the adjacent lifts of material.
- F. Compact the protective clay layer in Area 2, as shown on the Construction Drawings, to the performance criteria for compacted clay liner and cap specified in this Section. Protective clay layer in Areas 1 and 3, as shown on the Construction Drawings, shall be compacted to 95 percent of the standard Proctor maximum dry unit weight as determined by ASTM D 698. Use the specified smooth drum roller without vibration to compact the first 10-inch  $\pm$ 1-inch thick lift of the protective clay layer.
- G. Operate compaction equipment to prevent damage to, or disturbance of, leachate piping, liner penetration boxes, and geosynthetic materials. Operate compaction equipment parallel to the bottom of the protective clay layer, maintaining a "fluid motion" without sharp turns, fast starts or stops.
- H. Prepare the finished compacted clay liner and cap surface to be acceptable for placement of the overlying geosynthetic clay liner and cap in accordance with Section 02772.

### **3.06 PERFORATIONS**

- A. Backfill perforations in the compacted clay liner or cap resulting from survey stakes or other activities as specified in this Section. Perforations resulting from nuclear density tests, sand-cone, or drive cylinder density tests will be filled by the CQC Consultant.

- B. Prepare soil-bentonite mix for use in backfilling of perforations as specified in this Section. The mix shall consist of a minimum of 10 percent by weight bentonite granules mixed with clay liner and cap material by dry weight basis.
- C. Backfill perforations with soil-bentonite mix. Place soil-bentonite mix in perforations in approximately 3-inch thick loose lifts and rod tamp to compact.
- D. Perforations in the compacted clay liner and cap resulting from density testing will be backfilled with bentonite powder or granules or the soil-bentonite mix furnished by the Contractor and compacted by hand tamping by the CQC Consultant.

### 3.07 PROTECTION OF WORK

- A. Avoid crusting and desiccation cracking of compacted clay liner and cap. Regularly moisture condition the surface of the compacted clay liner and cap. If cracking is observed, scarify, moisture condition, and recompact the surface. Seal roll the surface of the clay to reduce evaporation, or alternatively protect exposed surfaces using light-colored or translucent membranes, such as Visqueen, that will inhibit drying of the clay.
- B. Repair areas of crusting or desiccation cracks deeper than 2 inches. Scarify the surface of such areas to a depth of 2 inches or to the depth of the desiccation cracks, whichever is greater, and then moisture condition, process, and recompact the area in accordance with the requirements of this Section.
- C. Using the specified equipment, seal the compacted clay liner and cap surface at the end of every working day and when precipitation is forecast.
- D. Compacted clay liner and cap may be protected using tarping, PVC geomembrane, or other means approved by the Construction Manager, to shed rainfall runoff during periods of extended rain.
- E. Use the specified equipment to seal the compacted clay liner and cap surface on which the geosynthetic clay liner and cap is to be placed to facilitate intimate contact between the geosynthetic clay liner and cap and the underlying compacted clay liner and cap surface.
- F. If the compacted clay liner and cap surface cannot be maintained in a moist condition to prevent desiccation, place a clay protection layer over the compacted clay liner and cap if construction of overlying layers or lifts is to be delayed more than 10 calendar days. Compact the clay protection layer by tracking with a bulldozer. The loose thickness of the clay protection layer shall be 7 inches  $\pm$  1 inch. The clay protection

layer can also be used to protect compacted clay liner and cap against excessive rainfall.

- G. Remove the compacted clay protection layer prior to placement of overlying lifts or the geosynthetic clay liner and cap. The clay protection layer may be removed in sections in coordination with ongoing construction. Where the clay protection layer is removed, prepare the surface to receive an overlying lift or the geosynthetic clay liner and cap and the finished surface as required by this Section.
- H. Protect the compacted clay liner and cap from freezing as specified in this section.
- I. Do not apply synthetic sealants or other chemical treatments to the compacted clay liner and cap material.

### **3.08 CONSTRUCTION QUALITY REQUIREMENTS**

- A. CQC Consultant will perform pre-conformance and conformance testing on soil and clay liner and cap material to establish compliance with this Section. The pre-conformance and conformance testing to be performed and testing frequencies shall be in the Construction Quality Assurance (CQA) Plan. Provide equipment such as shovels, hand augers, and backhoes and labor to assist the CQC Consultant in obtaining pre-conformance and conformance samples from excavations, stockpile, and borrow areas. Identify source(s) and quantity of clay liner and cap materials required from each source at least 15 calendar days prior to use.
- B. CQC Consultant will monitor compacted clay liner and cap construction as specified in accordance with this Section and the CQA Plan.
- C. CQC Consultant will perform soil performance testing on compacted lifts of clay liner and cap material to confirm compliance with this Section. The performance testing to be performed and testing frequencies shall be in accordance with the CQA Plan.
- D. If the CQC Consultant's performance tests indicate that any portion of the compacted clay liner and cap does not meet the requirements of this Section, the CQC Consultant will delineate the extent of the non-conforming area. Rework the non-conforming area until acceptable test results are obtained by the CQC Consultant.

### **3.09 SURVEY CONTROL**

- A. Survey the limits and grades of the finished surface of the compacted clay liner and cap in accordance with Section 02100.

### 3.10 TOLERANCE

- A. Construct the compacted clay liner and cap to within 0.0 to +0.3 feet of the thicknesses shown on the Construction Drawings.
- B. Construct the compacted clay liner and cap to within  $\pm 0.2$  feet of the grades indicated on the Construction Drawings.
- C. Provide survey information to the Construction Manager for the CQC Consultant to confirm the thicknesses and grades of completed areas of the compacted clay liner or cap. A minimum of 3 working days shall be allowed for the CQC Consultant to confirm and accept the survey results.

[END OF SECTION]

**SPECIFICATION COVER SHEET**

**SPECIFICATION SECTION:** 02230 **TITLE:** ROAD CONSTRUCTION

**Specifications By:** (Cognizant Engineer)  
 Signature [Signature] Date 5 May 00  
 Printed Name Michael J. Monteleone, P.E.  
 and Title Senior Project Engineer

**Scope and Format**  
**Checked By:** (Checker)  
 Signature [Signature] Date 5 May 00  
 Printed Name Michael J. Monteleone, P.E.  
 and Title Senior Project Engineer

**Detailed Requirements**  
**Checked by:** (Checker)  
 Signature [Signature] Date 5 May 2000  
 Printed Name Kwasi Badu-Tweneboah, Ph.D., P.E.  
 and Title Senior Project Engineer

**Overall Review By:** (PDP)  
 Signature [Signature] Date 8 May 2000  
 Printed Name J.F. Beech, Ph.D., P.E.  
 and Title Principal

**Approved by:** (DTL)  
 Signature [Signature] Date 8 May 2000  
 Printed Name J.F. Beech, Ph.D., P.E.  
 and Title Principal

**Record of Revision (Number and initial all revisions)**

Rev. No.	Reason	Date	By	Checked	Approval
0	Certified for Construction	08 May 00		KBT	

**SECTION 02230****ROAD CONSTRUCTION****PART 1 GENERAL****1.01 SCOPE**

- A. This Section includes impacted material haul roads, cell access ramps, access corridor, the Special Materials Transfer Area (SMTA), and other roads as shown on the Construction Drawings.

**1.02 RELATED SECTIONS AND PLANS**

- A. Section 02100 - Surveying
- B. Section 02110 - Clearing, Grubbing, and Stripping
- C. Section 02200 - Earthwork
- D. Section 02270 - Surface-Water Management and Erosion Control
- E. Section 02714 - Geotextiles
- F. Construction Quality Assurance (CQA) Plan
- G. Part 6 - Statement of Work
- H. Part 8 - Environmental Health & Safety/Training Requirements
- I. Part 9 - Quality Assurance Requirements

**1.03 REFERENCE**

- A. Latest version of Ohio Department of Transportation Construction and Material Specifications (Ohio DOT Specifications).

## **1.04 SUBMITTALS**

- A. For each source of base aggregate material, submit the following to the Construction Manager for review within 30 calendar days from Notice to Proceed:
  - 1. the source of the materials along with written certification from the supplier that the material meets the material requirements of this Section; and
  - 2. certification shall include test results as required by Ohio DOT Specifications for base aggregate materials demonstrating that it meets the requirements of items from the Ohio DOT Specifications specified in this Section.
- B. Provide a list of equipment, description of construction methods, and other required information to perform the construction activities described in this Section with the Contractor's Earthwork Work Plan specified in Section 02200.

## **1.05 HEALTH AND SAFETY REQUIREMENTS**

- A. Environmental health & safety/training requirements shall be in accordance with Part 8 of the Contract Documents.

## **1.06 CONTRACTOR'S QUALITY ASSURANCE**

- A. Contractor's quality assurance requirements shall be in accordance with Part 9 of the Contract Documents.

## **PART 2 PRODUCTS**

### **2.01 MATERIALS**

- A. Furnish base aggregate material consisting of crushed carbonate stone or crushed gravel, free of organic matter and other deleterious materials, which meets the requirements of Items 304.02 and 703.04 (2) of the Ohio DOT Specifications for aggregate base.
- B. Furnish a geotextile separator meeting the requirements of Section 02714.
- C. Furnish materials for compacted fill or clayey rockfill meeting the requirements of Section 02200.

### **2.02 EQUIPMENT**

- A. Furnish equipment for construction of impacted material haul roads, cell access ramps, access corridors, the SMTA, and other roads shown on the Construction Drawings in accordance with the requirements of this Section.

**PART 3 EXECUTION****3.01 GENERAL**

- A. Dust control during the performance of road construction activities described in this Section shall be in accordance with Part 6 of the Contract Documents.
- B. Install surface-water management and erosion controls in accordance with Section 02270.
- C. Perform clearing, grubbing, and stripping to the limits indicated on the Construction Drawings or identified by the Construction Manager, and in accordance with Section 02110 prior to any earthwork activity.

**3.02 SUBGRADE PREPARATION**

- A. Prepare subgrade for the road construction described in this Section in accordance with Section 02200.

**3.03 GEOTEXTILE PLACEMENT**

- A. Install the geotextile separator over the prepared subgrade in accordance with Section 02714.

**3.04 BASE AGGREGATE**

- A. Construct the base aggregate layer to the thickness, grades, and limits indicated on the Construction Drawings.
- B. Place the base aggregate material on top of the geotextile separator by end dumping and carefully spread using a track bulldozer. Do not operate equipment directly on the geotextile.
- C. Place the base aggregate in accordance with the requirements of Item 304.04 of the Ohio DOT Specifications.
- D. Compact the base aggregate in accordance with the requirements of Item 304.05 of the Ohio DOT Specifications.

**3.05 CONSTRUCTION QUALITY REQUIREMENTS**

- A. CQC Consultant will perform conformance testing on materials for compacted fill used for the construction described in this Section to establish compliance with this Section and Section 02200 as applicable. Conformance testing to be performed and minimum

testing frequencies shall be in accordance with the Construction Quality Assurance (CQA) Plan.

- B. CQC Consultant will monitor road construction in accordance with this Section and the CQA Plan.
- C. CQC Consultant will perform performance testing on compacted fill and/or compacted clayey rockfill used for the construction described in this Section to establish compliance with this Section and Section 02200. Performance test requirements and minimum testing frequencies shall be in accordance with the CQA Plan.

### **3.06 SURVEY CONTROL**

- A. Survey alignment and grades for roads, ramps, the SMTA, and corridor in accordance with Section 02100.

### **3.07 TOLERANCES**

- A. Construct the base aggregate to within 0.0 to +0.1 feet of the thickness indicated on the Construction Drawings.
- B. Construct the impacted material haul roads, cell access ramps, access corridor, the SMTA, and other roads shown on the Construction Drawings to within  $\pm 0.2$  feet of the grades indicated on the Construction Drawings.

[END OF SECTION]

**SPECIFICATION COVER SHEET**

**SPECIFICATION SECTION:** 02240 **TITLE:** NON-IMPACTED PROTECTIVE AND CONTOURING LAYERS

**Specifications By:** (Cognizant Engineer)  
 Signature [Signature] Date 5 May 00  
 Printed Name Michael J. Monteleone, P.E.  
 and Title Senior Project Engineer

**Scope and Format**  
**Checked By:** (Checker)  
 Signature [Signature] Date 5 May 00  
 Printed Name Michael J. Monteleone, P.E.  
 and Title Senior Project Engineer

**Detailed Requirements**  
**Checked by:** (Checker)  
 Signature [Signature] Date 5 May 2000  
 Printed Name Kwasi Badu-Tweneboah, Ph.D., P.E.  
 and Title Senior Project Engineer

**Overall Review By:** (PDP)  
 Signature [Signature] Date 8 May 2000  
 Printed Name J.F. Beech, Ph.D., P.E.  
 and Title Principal

**Approved by:** (DTL)  
 Signature [Signature] Date 8 May 2000  
 Printed Name J.F. Beech, Ph.D., P.E.  
 and Title Principal

**Record of Revision (Number and initial all revisions)**

Rev. No.	Reason	Date	By	Checked	Approval
0	Certified for Construction	08 May 00		KBT	J.F.B.

**SECTION 02240****NON-IMPACTED PROTECTIVE AND CONTOURING LAYERS****PART 1 GENERAL****1.01 SCOPE**

- A. This Section includes materials and placement for non-impacted protective layer and non-impacted contouring layer.

**1.02 RELATED SECTIONS AND PLANS**

- A. Section 02100 - Surveying
- B. Section 02200 - Earthwork
- C. Section 02225 - Compacted Clay Liner and Cap
- D. Section 02270 - Surface-Water Management and Erosion Control
- E. Section 02710 - Granular Drainage Material
- F. Section 02714 - Geotextiles
- G. Section 02930 - Vegetation
- H. Section 13000 - Borrow Area Management
- I. Section 13010 - Impacted Materials Placement
- J. Construction Quality Assurance (CQA) Plan
- K. Part 6 - Statement of Work
- L. Part 8 - Environmental Health & Safety/Training Requirements
- M. Part 9 - Quality Assurance Requirements

**1.03 REFERENCES**

- A. Latest version of American Society for Testing and Materials (ASTM) Standards:

1. ASTM D 698. Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft<sup>3</sup> (600 kN-m/m<sup>3</sup>)).
  2. ASTM D 2487. Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System).
- B. Reference Reports addressing On-Site Disposal Facility (OSDF) and borrow area site subsurface conditions:
1. *"Geotechnical Investigation Report, On-Site Disposal Facility"* [Parsons, 1995]. This report contains geotechnical data for the subsurface soils in the OSDF area.
  2. *"Disposal Facility Pre-Design Geotechnical Investigation, Soil Investigation Data Report, CERCLA-RCRA Unit 2"* [Science Applications International Corporation, 1995]. This report presents geotechnical data for the subsurface soils in the OSDF area.
  3. *"Geotechnical Data and Evaluation Report for East and South Field Borrow Areas"* [Parsons, 1996]. This report contains geotechnical data for the subsurface soils in the borrow area.

#### 1.04 SUBMITTALS

- A. Provide list of equipment, description of construction methods, and other required information to be used for the placement of non-impacted protective and contouring layers with the Contractor's Earthwork Work Plan specified in Section 02200.
- B. Provide plan and details for separating, diverting, and managing non-impacted and impacted runoff during placement of non-impacted contouring layer with the Contractor's Surface-Water Management and Erosion Control Work Plan specified in Section 02270.

#### 1.05 HEALTH AND SAFETY REQUIREMENTS

- A. Environmental health & safety/training requirements shall be in accordance with Part 8 of the Contract Documents.

#### 1.06 CONTRACTOR'S QUALITY ASSURANCE

- A. Contractor's quality assurance requirements shall be in accordance with Part 9 of the Contract Documents.

**PART 2 PRODUCTS****2.01 MATERIALS**

- A. Materials for the protective layer in the Impacted Runoff Catchment Area shall be non-impacted and meet the requirements for leachate collection system (LCS) granular drainage layer material specified in Section 02710.
- B. Materials for the non-impacted protective layer, as shown on the Construction Drawings, shall be compacted fill material specified in Section 02200 with visible rock particles not larger than 3 inches. Materials shall be obtained from OSDF cell excavation, trenching, and stockpiles shown on the Construction Drawings. Obtain additional material for non-impacted protective layer, if required, from the on-site borrow area indicated on the Construction Drawings. Borrow area management shall be in accordance with Section 13000.
- C. Materials for the non-impacted contouring layer shall be compacted fill material specified in Section 02200 with visible rock particles not larger than 4 inches. Material shall be obtained from the OSDF cell excavation, trenching, and stockpiles shown on the Construction Drawings. Obtain additional material for the non-impacted contouring layer, if required, from the on-site borrow area indicated on the Construction Drawings. Borrow area management shall be in accordance with Section 13000.
- D. Construction water for moisture conditioning non-impacted protective and contouring layers shall be obtained from the on-site water source shown on the Construction Drawings.

**2.02 EQUIPMENT**

- A. Furnish equipment to perform work specified in this Section.

**PART 3 EXECUTION****3.01 GENERAL**

- A. Perform construction activities in such a manner that equipment operating in radiologically controlled areas (RCAs) does not operate in non-RCAs. Equipment operating in RCAs shall be washed by the Contractor and radiologically surveyed and released by Fluor Fernald, Inc. prior to exiting for use in non-RCAs.
- B. Dust control measures shall be in accordance with Part 6 of the Contract Documents.
- C. Assist the CQC Consultant in obtaining soil samples for conformance testing.

- D. Excavate the material identified by the conformance test results as a source for the non-impacted protective layer or the non-impacted contouring layer as specified in this Section. Segregate and stockpile nonconforming soils from the conforming material at stockpile areas shown on the Construction Drawings. Stabilize stockpiles in accordance with Section 02930.
- E. Construct the non-impacted protective and contouring layers to the limits, grades and minimum thicknesses shown on the Construction Drawings. The thickness of the non-impacted protective and contouring layers at any location shall be measured perpendicular to the plane of the slope at that location.
- F. Do not place frozen non-impacted protective or contouring layer material, nor place non-impacted protective or contouring layer material on frozen ground. Do not place or compact non-impacted protective or contouring layer material at temperatures below 32 degrees Fahrenheit (less than 32°F) unless authorized in writing by the Construction Manager. If cold weather (less than 32°F) material placement and/or compaction is implemented, prepare and submit a written plan, as part of the Contractor's Earthwork Work Plan specified in Section 02200, describing proposed cold weather placement and compaction procedures and the weather parameters for which cold weather operations are proposed.
- G. If a non-impacted contouring layer material lift freezes after compaction, remove the frozen material, scarify the remaining unfrozen material, and replace and compact in accordance with this Section prior to placing the next lift of non-impacted contouring layer material. Do not reuse frozen material until it has thawed and has been reprocessed to the specified moisture content. Include the protective measures to be taken for placement, compaction, and protection of non-impacted protective and contouring layers under construction during freezing conditions in the Contractor's Earthwork Work Plan specified in Section 02200. Protective measures may include the use of thermal blankets or a sacrificial soil layer.
- H. Install surface-water and erosion control measures to protect the non-impacted protective or contouring layers in accordance with Section 02270.

### **3.02 CONSTRUCTION OF NON-IMPACTED PROTECTIVE LAYER**

- A. Place non-impacted protective layer material only after completion of the following activities:
  - 1. conformance testing and written confirmation of compliance of material by the CQC Consultant;

2. performance testing and written confirmation of compliance of underlying layers, including acceptance of Contractor's survey results for underlying layers by CQC Consultant; and
  3. written approval of the non-impacted protective layer material and source by the Construction Manager.
- B. Place the non-impacted protective layer above the geotextile filter as shown on the Construction Drawings.
  - C. Do not use equipment to place, spread, or compact the non-impacted protective layer that produces ground pressures on the underlying geotextile filter that exceed the requirements of Section 02714. Do not drive equipment directly on the geotextile filter.
  - D. Place, spread, and compact non-impacted protective layer in the Impacted Runoff Catchment Area in accordance with the requirements of Section 02710.
  - E. Place, spread, and compact the non-impacted protective layer at the intercell berm, as shown on the Construction Drawings, with equipment meeting the requirements of Section 02714. There are no moisture or dry unit weight requirements for the non-impacted protective layer. The moisture content shall be within a range that provides a material that can be spread in one 12- to 15-inch thick loose lift and compacted by a low ground pressure bulldozer meeting the requirements of Section 02714. Seal the surface of the non-impacted protective layer as specified for compacted fill in Section 02200. Perform work during inclement weather in accordance with Section 02200.
  - F. Compact the non-impacted protective layer material during placement by tracking with a low ground pressure bulldozer meeting the requirements of Section 02714. Compact with at least two passes of the bulldozer.
  - G. Place the non-impacted protective layer in one loose lift to meet the minimum thickness and grades indicated on the Construction Drawings. Meet the tolerance requirements of this Section.
  - H. Continuously remove visible rock particles having a maximum dimension greater than 3 inches from the non-impacted protective layer during construction.
  - I. Protect the non-impacted protective layer at the intercell berm shown on the Construction Drawings.

### **3.03 CONSTRUCTION OF NON-IMPACTED CONTOURING LAYER**

- A. Place non-impacted contouring layer material only after completion of the following activities:

1. conformance testing and written confirmation of compliance of material by the CQC Consultant;
  2. performance testing and written confirmation of compliance of underlying layers including acceptance of Contractor's survey results for underlying layers by CQC Consultant; and
  3. written approval of the non-impacted contouring layer material and source by the Construction Manager.
- B. Separate and divert non-impacted surface water from impacted surface water during construction of the non-impacted contouring layer in accordance with the Contractor's Surface Water Management and Erosion Control Work Plan specified in Section 02270. Impacted surface water shall be diverted from the non-impacted contouring layer material during placement, spreading, and compaction.
- C. Direct impacted and non-impacted runoff from impacted material and the non-impacted contouring layer to the Impacted Runoff Catchment Area of the adjacent down-gradient cell shown on the Construction Drawings until the second lift of compacted clay cap is compacted. Direct non-impacted runoff from areas with second lift of compacted clay cap to drainage channels outside the perimeter berm baseline in accordance with the Contractor's Surface-Water Management and Erosion Control Work Plan specified in Section 02270.
- D. Prepare select impacted material layer surface in accordance with Section 13010 and survey in accordance with Section 02100 prior to beginning non-impacted contouring layer construction. Scarify surface on which the first lift of non-impacted contouring layer material is to be placed by discing or tracking with a bulldozer.
- E. Place the non-impacted contouring layer above the select impacted material layer below the final cover system as shown on the Construction Drawings.
- F. Place the non-impacted contouring layer in two loose lifts with the first lift 10 inches  $\pm$  1 inch thick.
- G. Compact each lift of non-impacted contouring layer material to at least 95 percent of the material standard Proctor maximum dry unit weight (ASTM D 698) and within  $\pm$  3 percentage points of the standard Proctor optimum moisture content (ASTM D 698). Testing of the first compacted lift shall be limited to the top 6 inches of the lift thickness.
- H. Prior to placing the second lift of non-impacted contouring layer material over the compacted first lift, thoroughly scarify the first lift by discing, raking, or tracking with a bulldozer.

- I. Place the second lift of the non-impacted contouring layer to meet the minimum thickness and grades indicated on the Construction Drawings. Meet the tolerance requirements of this Section.
- J. Scarify, moisture condition, compact, and seal the non-impacted contouring layer as specified for compacted fill in Section 02200. Perform work during inclement weather in accordance with Section 02200.
- K. Continuously remove visible rock particles having a maximum dimension greater than 4 inches from the non-impacted contouring layer during construction.
- L. Prepare the finished non-impacted contouring layer surface to be acceptable for placement of the first lift of the overlying compacted clay cap in accordance with Section 02225.

### **3.04 EQUIPMENT WASHING**

- A. Wash equipment used to place non-impacted contouring layer materials that come in contact with impacted material in accordance with Section 13010.

### **3.05 PERFORATIONS**

- A. Backfill perforations in the non-impacted protective and contouring layers resulting from survey stakes or other activities with soil-bentonite mix as specified in Section 02225, except that this does not include the protective layer in the Impacted Runoff Catchment Area. Perforations resulting from nuclear density tests and sand-cone or drive cylinder density tests performed in the non-impacted contouring layer will be filled by the CQC Consultant in accordance with Section 02225.

### **3.06 CONSTRUCTION QUALITY REQUIREMENTS**

- A. CQC Consultant will perform conformance testing on non-impacted protective layer and non-impacted contouring layer materials to confirm compliance with this Section and Sections 02200 and 02710, as applicable. Conformance testing to be performed, including minimum testing frequencies, shall be in accordance with the Construction Quality Assurance (CQA) Plan. Provide equipment such as shovels, hand augers, and backhoes and labor to assist CQC Consultant in obtaining conformance samples from excavation, stockpiles, and borrow areas. Identify sources and quantity of non-impacted protective or contouring layer materials required from each source at least 15 calendar days prior to use.
- B. CQC Consultant will monitor non-impacted protective and contouring layers construction in accordance with this Section and the CQA Plan.

- C. CQC Consultant will perform performance testing on compacted lifts of non-impacted contouring layer material to confirm compliance with this Section. Performance testing, including minimum testing frequencies, shall be in accordance with the CQA Plan.

### 3.07 SURVEY CONTROLS

- A. Survey the locations, limits, and grades of the non-impacted protective layer and the non-impacted contouring layer in accordance with Section 02100.

### 3.08 TOLERANCE

- A. Construct the non-impacted protective and contouring layers to within 0.0 to +0.1 feet of the thickness shown on the Construction Drawings.
- B. Construct the non-impacted contouring layer to within -0.3 to +0.1 feet of the grades indicated on the Construction Drawings.

[END OF SECTION]

**SPECIFICATION COVER SHEET**

SPECIFICATION SECTION: 02250 TITLE: VEGETATIVE SOIL LAYER

Specifications By: Signature [Signature] 5 May 00  
 (Cognizant Engineer) Date

Printed Name Michael J. Monteleone, P.E.  
and Title Senior Project Engineer

Scope and Format  
 Checked By: Signature [Signature] 5 May 00  
 (Checker) Date

Printed Name Michael J. Monteleone, P.E.  
and Title Senior Project Engineer

Detailed Requirements  
 Checked by: Signature [Signature] 5 May 2000  
 (Checker) Date

Printed Name Kwasi Badu-Tweneboah, Ph.D., P.E.  
and Title Senior Project Engineer

Overall Review By: Signature [Signature] 8 May 2000  
 (PDP) Date

Printed Name J.F. Beech, Ph.D., P.E.  
and Title Principal

Approved by: Signature [Signature] 8 May 2000  
 (DTL) Date

Printed Name J.F. Beech, Ph.D., P.E.  
and Title Principal

**Record of Revision (Number and initial all revisions)**

Rev. No.	Reason	Date	By	Checked	Approval
0	Certified for Construction	08 May 00		KBT	JFB

**SECTION 02250**  
**VEGETATIVE SOIL LAYER**

**PART 1 GENERAL**

**1.01 SCOPE**

- A. This Section includes materials and placement for the vegetative soil layer.

**1.02 RELATED SECTIONS AND PLANS**

- A. Section 02100 - Surveying
- B. Section 02200 - Earthwork
- C. Section 02225 - Compacted Clay Liner and Cap
- D. Section 02270 - Surface-Water Management and Erosion Control
- E. Section 02930 - Vegetation
- F. Section 13000 - Borrow Area Management
- G. Construction Quality Assurance (CQA) Plan
- H. Part 6 - Statement of Work
- I. Part 8 - Environmental Health & Safety/Training Requirements
- J. Part 9 - Quality Assurance Requirements

**1.03 REFERENCES**

- A. Latest version of American Society for Testing and Materials (ASTM) Standards:
1. ASTM D 698. Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft<sup>3</sup> (600 kN-m/m<sup>3</sup>)).
  2. ASTM D 2487. Standard Classification of Soil for Engineering Purposes (Unified Soil Classification System).

- B. Reference Reports addressing On-Site Disposal Facility (OSDF) and borrow area site subsurface conditions:
1. "Geotechnical Investigation Report, On-Site Disposal Facility" [Parsons, 1995]. This report contains geotechnical data for the subsurface soils in the OSDF area.
  2. "Disposal Facility Pre-Design Geotechnical Investigation, Soil Investigation Data Report, CERCLA-RCRA Unit 2" [Science Applications International Corporation, 1995]. This report presents geotechnical data for the subsurface soils in the OSDF area.
  3. "Geotechnical Data and Evaluation Report for East and South Field Borrow Areas" [Parsons, 1996]. This report contains geotechnical data for the subsurface soils in the borrow area.

#### 1.04 SUBMITTAL

- A. Provide a list of equipment, description of construction methods, and other required information to be used for vegetative soil layer placement with Contractor's Earthwork Work Plan specified in Section 02200.

#### 1.05 HEALTH AND SAFETY REQUIREMENTS

- A. Environmental health & safety/training requirements shall be in accordance with Part 8 of the Contract Documents.

#### 1.06 CONTACTOR'S QUALITY ASSURANCE

- A. Contractor's quality assurance requirements shall be in accordance with Part 9 of the Contract Documents.

### PART 2 PRODUCTS

#### 2.01 MATERIALS

- A. Material for the vegetative soil layer shall be obtained from the OSDF cell excavation, trenching, and stockpiles shown on the Construction Drawings. Obtain additional material for vegetative soil layer, if required, from on-site borrow area indicated on the Construction Drawings. Borrow area management shall be in accordance with Section 13000.
- B. Material for the vegetative soil layer shall be relatively free of debris, foreign objects, large rock fragments, roots, and organics. Visible rock particles shall be maximum dimension of 4 inches. Material shall conform to CL, SC, or GC according to the Unified Soil Classification System (per ASTM D 2487).

- C. Construction water for moisture conditioning vegetative soil layer shall be obtained from the on-site water source shown on the Construction Drawings.

## 2.02 EQUIPMENT

- A. Furnish equipment to perform work specified in this Section.

## PART 3 EXECUTION

### 3.01 GENERAL

- A. Install surface-water management and erosion control measures to protect the vegetative soil layer in accordance with Section 02270.
- B. Perform construction activities in such a manner that equipment operating in radiologically controlled areas (RCAs) does not operate in non-RCAs. Equipment operating in RCAs shall be washed by the Contractor and radiologically surveyed and released by Fluor Fernald, Inc. prior to exiting for use in non-RCAs.
- C. Dust control measures shall be in accordance with Part 6 of the Contract Documents.
- D. Assist the CQC Consultant in obtaining soil samples for conformance testing.
- E. Excavate the material identified by the conformance test results as a source for the vegetative soil layer in accordance with Section 02200. Segregate and stockpile non-conforming soils from the conforming material at stockpile areas shown on the Construction Drawings. Stabilize stockpiles in accordance with Section 02930.
- F. Continuously remove visible rock particles having a maximum dimension greater than 4 inches during excavation, material placement, and compaction.
- G. Construct the vegetative soil layer to the limits, grades, and minimum thickness shown on the Construction Drawings. The thickness of the vegetative soil layer at any location shall be measured perpendicular to the plane of the slope at that location.
- H. Do not place frozen vegetative soil layer material, nor place vegetative soil layer material on frozen ground. Do not place or compact vegetative soil layer material at temperatures below 32 degrees Fahrenheit (less than 32°F) unless authorized in writing by the Construction Manager. If cold weather (less than 32°F) material placement

and/or compaction is implemented, prepare and submit a written plan, as part of the Contractor's Earthwork Work Plan specified in Section 02200, describing proposed cold weather placement and compaction procedures and the weather parameters for which cold weather operations are proposed.

- I. If vegetative soil layer material lift freezes after compaction, remove the frozen material, scarify the remaining unfrozen material, and replace and compact in accordance with this Section prior to placing succeeding lift of vegetative soil layer material. Do not reuse frozen material until it has thawed and has been reprocessed to the specified moisture content. Include the protective measures to be taken for placement, compaction, and protection of vegetative soil layer under construction during freezing conditions in the Contractor's Earthwork Work Plan specified in Section 02200. Protective measures may include the use of thermal blankets or a sacrificial soil layer.

### 3.02 PLACEMENT

- A. Place vegetative soil layer material only after completion of the following activities:
  1. conformance testing and written confirmation of compliance of material by the CQC Consultant;
  2. performance testing and written confirmation of compliance of underlying layers, including acceptance of Contractor's survey results for underlying layers by CQC Consultant; and
  3. written approval of the vegetative soil layer material and source by the Construction Manager.
- B. Place the vegetative soil layer material as shown on the Construction Drawings.
- C. Place the vegetative soil layer material in 8-inch  $\pm$ 1-inch thick loose lifts.
- D. Prior to placing a succeeding lift of vegetative soil layer material over the previously compacted lift, thoroughly scarify the previous compacted lift to a maximum depth of 2 inches by discing, raking, or tracking with a bulldozer.
- E. Limit the trafficking of scarified surfaces by trucks or other equipment, except moisture conditioning and compaction equipment.
- F. Prepare the final lift of vegetative soil layer material to meet the minimum thickness and grades indicated on the Construction Drawings. Meet the tolerance requirements of this Section.

- G. Do not place a succeeding lift of vegetative soil layer material until the CQC Consultant has completed performance testing of the previously compacted lift in that area.
- H. Moisture condition the vegetative soil layer material prior to compaction, if necessary, as specified for compacted fill in Section 02200.
- I. Do not place vegetative soil layer material during periods of precipitation. Placement may occur during periods of misting or drizzle, but only if authorized by the Construction Manager.
- J. Leave the entire area of exposed vegetative soil layer in a smooth, seal-rolled state to promote runoff at the end of each day when precipitation is forecast and/or at the completion of the compaction activities in that area.

### 3.03 COMPACTION

- A. Compact each lift of vegetative soil layer to at least 92 percent of its standard Proctor maximum dry unit weight as determined by ASTM D 698. Compact vegetative soil layer at a moisture content within  $\pm 4$  percent of the standard Proctor optimum moisture content as determined by ASTM D 698.
- B. Moisture condition the vegetative soil layer material to achieve the compaction requirements. Use equipment designed to apply water uniformly and in controlled quantities to wet the material as required. Use discing, raking, or other appropriate methods to dry the material as required. During wetting or drying, regularly disc, rake, or otherwise mix the material to thoroughly blend the moisture throughout the lift. Material for the first lift shall be moisture conditioned, if required, off the placement area at a location approved by the Construction Manager.
- C. Compact vegetative soil layer material by tracking with a bulldozer, rolling with a static padfoot or sheepsfoot compactor, or by other equipment approved by the Construction Manager.

### 3.04 PERFORATIONS

- A. Perforations in the vegetative soil layer resulting from survey stakes or other activities shall be backfilled with material for the vegetative soil layer and compacted in accordance with this Section. Perforation resulting from nuclear density tests and sand cone or drive cylinder tests will be filled by the CQC Consultant in accordance with Section 02225 with material for the vegetative soil layer and compacted.

**3.05 CONSTRUCTION QUALITY REQUIREMENT**

- A. CQC Consultant will perform conformance testing on the vegetative soil layer material to establish compliance with this Section. Conformance testing to be performed, including minimum testing frequencies, shall be in accordance with the Construction Quality Assurance (CQA) Plan. Provide equipment and labor to support CQC Consultant in obtaining conformance samples from excavation, stockpiles, and borrow areas. Identify sources and quantity of vegetative soil layer material required from each source at least 15 calendar days prior to use.
- B. CQC Consultant will monitor vegetative soil layer construction in accordance with this Section and the CQA Plan.
- C. CQC Consultant will perform performance testing on compacted lifts of vegetative soil layer material to confirm compliance with this Section. Performance testing, including minimum testing frequencies, shall be in accordance with the CQA Plan.

**3.06 SURVEY CONTROL**

- A. Survey the limits and finished surface of the vegetative soil layer in accordance with Section 02100.

**3.07 TOLERANCE**

- A. Construct the vegetative soil layer to within  $\pm 0.1$  feet of the thickness shown on the Construction Drawings.

[END OF SECTION]

**SPECIFICATION COVER SHEET**

**SPECIFICATION SECTION:** 02270 **TITLE:** SURFACE-WATER MANAGEMENT AND EROSION CONTROL

**Specifications By:** Signature [Signature] 5 May 00  
 (Cognizant Engineer) Date  
Printed Name Michael J. Monteleone, P.E.  
and Title Senior Project Engineer

**Scope and Format**  
**Checked By:** Signature [Signature] 5 MAY 2000  
 (Checker) Date  
Printed Name Daniel G. Pass, P.E.  
and Title Assistant Project Engineer

**Detailed Requirements**  
**Checked by:** Signature [Signature] 5 May 2000  
 (Checker) Date  
Printed Name Kwasi Badu-Tweneboah, Ph.D., P.E.  
and Title Senior Project Engineer

**Overall Review By:** Signature [Signature] 8 May 2000  
 (PDP) Date  
Printed Name J.F. Beech, Ph.D., P.E.  
and Title Principal

**Approved by:** Signature [Signature] 8 May 2000  
 (DTL) Date  
Printed Name J.F. Beech, Ph.D., P.E.  
and Title Principal

**Record of Revision (Number and initial all revisions)**

Rev. No.	Reason	Date	By	Checked	Approval
0	Certified for Construction	8 May 00		WBT	J.F.B.

**SECTION 02270****SURFACE-WATER MANAGEMENT AND EROSION CONTROL****PART 1 GENERAL****1.01 SCOPE**

- A. This Section includes materials and placement of silt fence, erosion mat, check dams, construction entrances, diversions, ditches, channels, berms, and stabilization; and maintenance of sedimentation basins and surface-water management and erosion control measures.
- B. Surface-water management and erosion control for the impacted material placement shall be in accordance with Section 13010.

**1.02 RELATED SECTIONS AND PLANS**

- A. Section 02100 - Surveying
- B. Section 02200 - Earthwork
- C. Section 02240 - Non-Impacted Protective and Contouring Layers
- D. Section 02271 - Riprap
- E. Section 02721 - Culverts
- F. Section 02930 - Vegetation
- G. Section 13010 - Impacted Materials Placement
- H. Surface-Water Management and Erosion Control (SWMEC) Plan
- I. Construction Quality Assurance (CQA) Plan
- J. Part 6 - Statement of Work
- K. Part 8 - Environmental Health & Safety/Training Requirements
- L. Part 9 - Quality Assurance Requirements

### 1.03 REFERENCES

- A. Latest version of Ohio Department of Natural Resources (ODNR) Rainwater and Land Development Standards (ODNR Rainwater and Land Development Standards).

### 1.04 SUBMITTALS

- A. Submit to the Construction Manager for review within 15 calendar days from Notice to Proceed, Contractor's Surface-Water Management and Erosion Control Work Plan that shall be prepared in accordance with this Section, Section 02240, Section 13010, ODNR Rainwater and Land Development Standards, and the Surface-Water Management and Erosion Control (SWMEC) Plan, and shall include but not be limited to the following:
  - 1. descriptions of the surface-water management and erosion control measures to be implemented throughout the duration of the Contract;
  - 2. a list of equipment, description of methods, and other required information for installing and maintaining surface-water management and erosion control measures specified in this Section;
  - 3. drawings showing, in plan view, the location and sequencing of the surface-water management and erosion control measures and other required information for installation of surface-water management and erosion control measures;
  - 4. drawings showing details of the surface-water management and erosion control measures; and
  - 5. calculations supporting the selection and use of surface-water management and erosion control measures.
- B. Submit the following to the Construction Manager for review within 15 calendar days from Notice to Proceed:
  - 1. manufacturer's product data and recommended methods of installation for products used for surface-water management and erosion control measures; and
  - 2. certification from the supplier or Manufacturer that products meet the requirements of this Section.

### 1.05 HEALTH AND SAFETY REQUIREMENTS

- A. Environmental health & safety/training requirements shall be in accordance with Part 8 of the Contract Documents.

**1.06 CONTRACTOR'S QUALITY ASSURANCE**

- A. Contractor's quality assurance requirements shall be in accordance with Part 9 of the Contract Documents.

**PART 2 PRODUCTS**

**2.01 SILT FENCE**

- A. Furnish silt fence with either woven or nonwoven geotextile. Silt fence shall:
  1. be woven geotextile consisting of slit films of polypropylene treated with ultraviolet light stabilizers, or nonwoven geotextile consisting of long chain polymeric filaments or polyester yarns;
  2. be inert to chemicals commonly found in soils and to hydrocarbons;
  3. be resistant to mildew, rot, insects, and rodent attack; and
  4. have geotextile and fence post properties and minimum dimensions in accordance with this Section and ODNR Rainwater and Land Development Standards.

**2.02 EROSION MAT**

- A. Furnish erosion mat consisting of American Excelsior Company, Curlex II matting or approved equal.
- B. Furnish erosion mat that will resist degradation for a minimum 6-month period after installation.
- C. Furnish erosion mat having a permissible velocity of 7 feet per second (fps).

**2.03 STABILIZATION**

- A. Materials for stabilization, including vegetation and crusting agent, shall be in accordance with Section 02930.

**2.04 OTHER MATERIALS**

- A. Riprap shall be in accordance with Section 02271.
- B. Culverts shall be in accordance with Section 02721.
- C. Materials for berms shall be as specified for compacted fill in Section 02200.

- D. Construction entrances shall be in accordance with ODNR Rainwater and Land Development Standards.
- E. Diversions and channels shall be in accordance with ODNR Rainwater and Land Development Standards.
- F. Materials for other surface-water management and erosion controls shall be in accordance with ODNR Rainwater and Land Development Standards.

## 2.05 EQUIPMENT

- A. Furnish equipment to perform work specified in this Section.

## PART 3 EXECUTION

### 3.01 INSTALLATION

- A. Silt Fence
  - 1. Install silt fence in accordance with, and at the locations required by, the Contractor's Surface-Water Management and Erosion Control Work Plan.
- B. Erosion Mat
  - 1. Provide erosion mat at the locations indicated on the Construction Drawings and Contractor's Surface-Water Management and Erosion Control Work Plan. Begin installation in an area within 48 hours after seeding, as specified in Section 02930, has been completed in that area.
  - 2. Place erosion mat on a prepared surface that is free of deleterious vegetation, trash, ruts, and rocks.
  - 3. Overlap adjacent erosion mats in a manner such that they are shingled in the direction of water flow. Overlap distance shall be in accordance with the Manufacturer's recommendations.
  - 4. Install and staple erosion mat in accordance with Manufacturer's recommendations.
- C. Install check dams in ditches and channels in accordance with ODNR Rainwater and Land Development Standards.
- D. Apply crusting agents in accordance with Section 02930. Areas of crusting agent application shall be approved in advance by the Construction Manager.
- E. Stabilize and vegetate disturbed areas in accordance with Section 02930.

- F. Install riprap in accordance with Section 02271 and as shown on the Construction Drawings.
- G. Construct channels, ditches, and berms as shown on the Construction Drawings and in accordance with the Contractor's Surface-Water Management and Erosion Control Work Plan. Earthwork for channels, ditches, and berms shall be in accordance with Section 02200.
- H. Install construction entrances in accordance with the Contractor's Surface-Water Management and Erosion Control Work Plan.
- I. Install additional surface-water management and erosion controls in accordance with the Contractor's Surface-Water Management and Erosion Control Work Plan.

### 3.02 ADDITIONAL REQUIREMENTS

- A. Prevent the runoff of polluting substances such as silt, clay, fuels, oils, and contaminated soils into water supplies and surface waters in accordance with the Contractor's Surface-Water Management and Erosion Control Work Plan.
- B. Remove accumulated silt and debris from behind the face of the silt fence when the silt deposits reach approximately one half the height of the fence. Replace silt fence geotextile damaged during maintenance operations. Removed silt and debris shall be placed in the OSDF constructed cells in accordance with Section 13010 or stockpiled in locations approved by the Construction Manager.

### 3.03 SURVEY CONTROL

- A. Survey the final locations of surface-water management and erosion control measures in accordance with Section 02100.

### 3.04 MAINTENANCE

- A. Clean, maintain, repair, and replace surface-water management and erosion controls for the duration of the Contract in accordance with the Contractor's Surface-Water Management and Erosion Control Work Plan.
- B. Maintain erosion control measures and existing sedimentation basins in accordance with Part 6 of the Contract Documents.

### 3.05 INSPECTIONS

- A. Inspect surface-water management and erosion control measures and sedimentation basins to evaluate their effectiveness and need for maintenance. Any required repairs to the surface-water management and erosion control measures and sedimentation basins shall be initiated upon discovery, but no later than 24 hours after discovery. Inspections shall occur, at a minimum, at the following frequencies:
1. weekly;
  2. daily after each rain event exceeding 0.5 inches; and
  3. at least daily during prolonged rainfall events.
- B. Records of inspections shall be kept on file on-site by Contractor and shall be submitted monthly to the Construction Manager. The records of inspection shall include the following:
1. summary of the scope of the inspection;
  2. name of inspector;
  3. inspection date;
  4. inspection location;
  5. purpose of the inspection (i.e., regular weekly, following a storm, etc.);
  6. observations relative to performance of the surface-water management and erosion control measures;
  7. any necessary corrective actions; and
  8. corrective actions completed and their performance since the previous inspection.

### 3.06 CONSTRUCTION QUALITY REQUIREMENTS

- A. CQC Consultant will monitor the installation and maintenance of surface-water management and erosion control measures in accordance with this Section and the Construction Quality Assurance (CQA) Plan.

[END OF SECTION]

**SPECIFICATION COVER SHEET**

**SPECIFICATION SECTION:** 02271 **TITLE:** RIPRAP

**Specifications By:** (Cognizant Engineer)  
 Signature [Signature] Date 5 May 00  
 Printed Name Michael J. Monteleone, P.E.  
 and Title Senior Project Engineer

**Scope and Format**  
**Checked By:** (Checker)  
 Signature [Signature] Date 5 May 00  
 Printed Name Michael J. Monteleone, P.E.  
 and Title Senior Project Engineer

**Detailed Requirements**  
**Checked by:** (Checker)  
 Signature [Signature] Date 5 May 2000  
 Printed Name Kwasi Badu-Tweneboah, Ph.D., P.E.  
 and Title Senior Project Engineer

**Overall Review By:** (PDP)  
 Signature [Signature] Date 8 May 2000  
 Printed Name J.F. Beech, Ph.D., P.E.  
 and Title Principal

**Approved by:** (DTL)  
 Signature [Signature] Date 8 May 2000  
 Printed Name J.F. Beech, Ph.D., P.E.  
 and Title Principal

**Record of Revision (Number and initial all revisions)**

Rev. No.	Reason	Date	By	Checked	Approval
0	Certified for Construction	08 May 00		KBT	J.F.

**SECTION 02271****RIPRAP****PART 1 GENERAL****1.01 SCOPE**

- A. This Section includes riprap materials and placement.

**1.02 RELATED SECTIONS AND PLANS**

- A. Section 02100 - Surveying
- B. Section 02200 - Earthwork
- C. Section 02270 - Surface-Water Management and Erosion Control
- D. Section 02714 - Geotextiles
- E. Construction Quality Assurance (CQA) Plan
- F. Part 8 - Environmental Health & Safety/Training Requirements
- G. Part 9 - Quality Assurance Requirements

**1.03 REFERENCES**

- A. Latest version of Ohio Department of Transportation Construction and Material Specifications (Ohio DOT Specifications).
- B. Latest version of American Society for Testing and Materials (ASTM) Standard:
  - 1. ASTM C 127. Standard Test Method for Specific Gravity and Absorption of Coarse Aggregate.
- C. Latest version of American Association of State Highway and Transportation Officials (AASHTO) Standard:
  - 1. AASHTO T 103. Standard Test Method for Soundness of Aggregate by Freezing and Thawing.
- D. *"Off-Site Borrow Materials Geotechnical Evaluation Report"* [Parsons, 1996]. This report presents geotechnical data for potential off-site borrow sources for On-Site

Disposal Facility (OSDF) construction materials, including fine concrete aggregates (sand), coarse concrete aggregates (gravel), pea gravel, and riprap.

#### **1.04 SUBMITTALS**

- A. Submit the following to the Construction Manager for review with the Contractor's Surface-Water Management and Erosion Control Work Plan specified in Section 02270, within 15 calendar days from Notice to Proceed:
  - 1. the source of the riprap;
  - 2. certification from the supplier that the Riprap Type C, as shown on the Construction Drawings, meets the material requirements of this Section and tests were performed on a representative sample of Type C Dumped Rock Fill, as defined in Item 601.07 of Ohio DOT Specifications, in accordance with ASTM C 127 and AASHTO T 103; and
  - 3. certification from the supplier that the Riprap Type D, as shown on the Construction Drawings, meets the material requirements of this Section and tests were performed on a representative sample of Type D Dumped Rock Fill, as defined in Item 601.07 of Ohio DOT Specifications, in accordance with AASHTO T 103.
- B. Notify the Construction Manager at least 14 calendar days in advance of shipment of riprap to the site. Allow Construction Manager and CQC Consultant to conduct visual inspection and approval of riprap materials designated for the project at the quarry producing the riprap.
- C. Provide list of equipment, description of construction methods, and other required information related to riprap placement in the Contractor's Earthwork Work Plan specified in Section 02200.

#### **1.05 HEALTH AND SAFETY REQUIREMENTS**

- A. Environmental health & safety/training requirements shall be in accordance with Part 8 of the Contract Documents.

#### **1.06 CONTRACTOR'S QUALITY ASSURANCE**

- A. Contractor's quality assurance requirements shall be in accordance with Part 9 of the Contract Documents.

**PART 2 PRODUCTS****2.01 MATERIALS**

- A. Stone used for riprap shall consist of field stone, rough unhewn quarry stone, or excavated rock with angular or fractured faces.
- B. Riprap Type C, as shown on the Construction Drawings, shall conform to requirements of Type C Dumped Rock Fill specified in Item 601.07 of the Ohio DOT Specifications.
- C. Furnish Riprap Type C having a minimum bulk specific gravity of 2.60 and a maximum absorption of 0.83 percent when measured in accordance with ASTM C 127.
- D. Riprap Type D, used for slope protection, channel and ditch lining, and other surface-water management and erosion control measures specified in Section 02270 and as shown on the Construction Drawings, shall conform to requirements of Type D Dumped Rock Fill specified in Item 601.07 of the Ohio DOT Specifications. In addition, the Riprap Type D shall be relatively free of laminations, seams, and fractures.
- E. The Riprap Types C and D shall be tested for soundness in accordance with AASHTO T 103 and have a maximum loss of 5 percent.
- F. Furnish geotextile filter as specified in Section 02714 and as shown on the Construction Drawings.

**2.02 EQUIPMENT**

- A. Furnish equipment to perform work specified in this Section.

**PART 3 EXECUTION****3.01 PLACEMENT**

- A. Place riprap to the thicknesses and limits shown on the Construction Drawings and for ditch check dams in accordance with Section 02270.
- B. Place riprap on geotextile filter or prepared subgrade as shown on the Construction Drawings. Geotextiles shall be shingled downgradient and shall be overlapped a minimum of 1 foot as specified in Section 02714.
- C. Carefully place riprap to avoid segregation or damage of the underlying material. Place the material in such a manner as to produce a uniform mass of riprap with the minimum

practicable percentage of voids. Distribute the larger pieces throughout the entire mass such that the finished riprap is free from non-uniform areas of small or large pieces. Hand placing, to a limited extent, may be required, but only to the extent necessary to obtain the results specified above.

- D. Do not place riprap by dumping into chutes or by similar methods likely to cause segregation of various sizes.
- E. Do not place riprap in a manner that causes damage to an underlying geotextile filter. Repair damaged geotextile in accordance with Section 02714.

### **3.02 CONSTRUCTION QUALITY REQUIREMENTS**

- A. CQC Consultant will perform conformance testing on Riprap Type C to confirm compliance with this Section. Conformance testing to be performed and minimum testing frequencies shall be in accordance with the Construction Quality Assurance (CQA) Plan.
- B. CQC Consultant will monitor riprap placement as specified in this Section and the CQA Plan.

### **3.03 SURVEY CONTROL**

- A. Survey the limits and thickness of the riprap in accordance with Section 02100.

### **3.04 TOLERANCE**

- A. Construct the riprap to within 0.0 to +0.3 feet of the thickness shown on the Construction Drawings.

[END OF SECTION]

**SPECIFICATION COVER SHEET**

**SPECIFICATION SECTION:** 02280 **TITLE:** BIOINTRUSION BARRIER

**Specifications By:** (Cognizant Engineer)  
 Signature: [Signature] Date: 5 May 00  
 Printed Name: Michael J. Monteleone, P.E.  
 and Title: Senior Project Engineer

**Scope and Format**  
**Checked By:** (Checker)  
 Signature: [Signature] Date: 5 May 00  
 Printed Name: Michael J. Monteleone, P.E.  
 and Title: Senior Project Engineer

**Detailed Requirements**  
**Checked by:** (Checker)  
 Signature: [Signature] Date: 5 May 2000  
 Printed Name: Kwasi Badu-Tweneboah, Ph.D., P.E.  
 and Title: Senior Project Engineer

**Overall Review By:** (PDP)  
 Signature: [Signature] Date: 8 May 2000  
 Printed Name: J.F. Beech, Ph.D., P.E.  
 and Title: Principal

**Approved by:** (DTL)  
 Signature: [Signature] Date: 8 May 2000  
 Printed Name: J.F. Beech, Ph.D., P.E.  
 and Title: Principal

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0	Certified for Construction	08 May 00		LSBT	J.F.B.

**SECTION 02280**  
**BIOINTRUSION BARRIER**

**PART 1 GENERAL**

**1.01 SCOPE**

- A. This Section includes materials and placement for the biointrusion barrier and biointrusion barrier choke stone.

**1.02 RELATED SECTIONS AND PLANS**

- A. Section 02100 - Surveying
- B. Section 02200 - Earthwork
- C. Section 02710 - Granular Drainage Material
- D. Construction Quality Assurance (CQA) Plan
- E. Part 6 - Statement of Work
- F. Part 8 - Environmental Health & Safety/Training Requirements
- G. Part 9 - Quality Assurance Requirements

**1.03 REFERENCES**

- A. Latest version of Ohio Department of Transportation Construction and Material Specifications (Ohio DOT Specifications).
- B. Latest version of American Society for Testing and Materials (ASTM) Standards:
  - 1. ASTM C 127      Standard Test Method for Specific Gravity and Absorption of Coarse Aggregate.
  - 2. ASTM C 136     Standard Method for Sieve Analysis of Fine and Coarse Aggregates.

- C. Latest version of American Association of State Highway and Transportation Officials (AASHTO) Standards:
  - 1. AASHTO M 43. Standard Specification for Standard Sizes of Coarse Aggregates for Highway Construction.
  - 2. AASHTO T 103. Standard Test Method for Soundness of Aggregate by Freezing and Thawing.
  
- D. “*Off-Site Borrow Materials Geotechnical Evaluation Report*” [Parsons, 1996]. This report presents geotechnical data for potential off-site borrow sources for On-Site Disposal Facility (OSDF) construction materials, including fine concrete aggregate (sand), coarse concrete aggregates (gravel), pea gravel, and riprap.

#### 1.04 SUBMITTALS

- A. For each source of biointrusion barrier material furnished by Contractor, submit the following to the Construction Manager for review within 30 calendar days from Notice to Proceed:
  - 1. the source and quantity of the biointrusion barrier material; and
  - 2. certification from the supplier that the biointrusion barrier material meets the material requirements of this Section and tests were performed on a representative sample in accordance with ASTM C 127 and AASHTO T 103.
  
- B. For each source of biointrusion barrier choke stone furnished by Contractor, submit the following to the Construction Manager for review within 30 calendar days from Notice to Proceed:
  - 1. the source and quantity of the choke stone;
  - 2. certification from the supplier that the choke stone meets the material requirements of this Section and tests were performed on a representative sample of choke stone in accordance with ASTM C 127 and ASTM C 136; and
  - 3. a 50-pound representative sample of the material from each source for visual examination, and testing, if necessary.
  
- C. Notify the Construction Manager at least 14 calendar days in advance of shipment of biointrusion barrier material and of biointrusion barrier choke stone materials to the site. Allow Construction Manager and CQC Consultant to conduct visual inspection and approval of biointrusion barrier and biointrusion barrier choke stone materials designated for the project at each quarry producing the biointrusion barrier and biointrusion barrier choke stone.

- D. Provide a list of equipment, description of construction methods, and other required information to be used for biointrusion barrier and choke stone construction with the Contractor's Earthwork Work Plan specified in Section 02200.

#### **1.05 HEALTH AND SAFETY REQUIREMENTS**

- A. Environmental health & safety/training requirements shall be in accordance with Part 8 of the Contract Documents.

#### **1.06 CONTRACTOR'S QUALITY ASSURANCE**

- A. Contractor's quality assurance requirements shall be in accordance with Part 9 of the Contract Documents.

### **PART 2 PRODUCTS**

#### **2.01 MATERIALS**

- A. Furnish biointrusion barrier and biointrusion barrier choke stone materials consisting of field stone, rough unhewn quarry stone, or excavated rock with angular or fractured faces, and free of deleterious material. Biointrusion barrier material passing through a 6-inch square opening shall consist of rock spalls and rock fines.
- B. Furnish biointrusion barrier material meeting the requirements of Type C Dumped Rock Fill specified in Item 601.07 of the Ohio DOT Specifications.
- C. Biointrusion barrier material shall be tested for soundness in accordance with AASHTO T 103 and have a maximum loss of 5 percent.
- D. Furnish biointrusion barrier choke stone material meeting AASHTO M 43 gradation requirements (per ASTM C 136) for No. 1 coarse aggregate.
- E. Furnish biointrusion barrier material and choke stone material having a minimum bulk specific gravity of 2.60 and a maximum absorption of 0.83 percent in accordance with ASTM C 127.

## **2.02 EQUIPMENT**

- A. Furnish equipment to load, haul, place, spread, and compact biointrusion barrier and biointrusion barrier choke stone materials.
- B. Furnish a Caterpillar CS-431 or equal smooth or padded steel drum vibratory compactor capable of delivering a dynamic force of 28,000 pounds  $\pm 15\%$  for placing biointrusion barrier choke stone.

## **PART 3 EXECUTION**

### **3.01 MATERIAL PLACEMENT**

- A. Place biointrusion barrier materials only after completion of the following activities:
  - 1. conformance testing and confirmation of compliance by CQC Consultant;
  - 2. performance testing and confirmation of compliance of underlying layers, including acceptance of Contractor's survey results of underlying layers; and
  - 3. written approval of the biointrusion barrier materials by the Construction Manager.
- B. Place biointrusion barrier materials to the grades and minimum thicknesses shown on the Construction Drawings. Place biointrusion barrier material above cover granular drainage material layer constructed in accordance with Section 02710. The thickness of the biointrusion barrier layer at any location shall be measured perpendicular to the slope at that location.
- C. Place biointrusion barrier material on top of the cover drainage material layer as shown on the Construction Drawings. Avoid damage of the underlying material. Maximum acceptable free-fall height of biointrusion barrier material during placement shall be three feet.
- D. Place the biointrusion barrier material in such a manner as to produce a uniform mass with the minimum practicable percentage of voids. Place so that the larger pieces are distributed throughout the entire mass. Hand-placing of biointrusion barrier material may be required to obtain these results.
- E. Place biointrusion barrier material from the toe of the slope and work upslope.
- F. Do not place the biointrusion barrier material by dumping into chutes or by similar methods likely to cause segregation of various sizes.
- G. Place the biointrusion barrier choke stone as a separate layer. Spread choke stone using a tracked bulldozer. Initially work the choke stone into the biointrusion barrier by

multiple passes of the bulldozer. Work choke stone into at least the top 6 inches of the biointrusion barrier by at least four passes of the vibratory compactor specified in this Section. Meet the tolerance requirements given in this Section.

### **3.02 CONSTRUCTION QUALITY REQUIREMENTS**

- A. CQC Consultant will perform conformance testing of the biointrusion barrier and biointrusion barrier choke stone material to confirm compliance with this Section. Conformance testing to be performed and minimum testing frequencies shall be in accordance with the Construction Quality Assurance (CQA) Plan.
- B. CQC Consultant will monitor biointrusion barrier and biointrusion barrier choke stone placement in accordance with this Section and the CQA Plan.

### **3.03 SURVEY CONTROL**

- A. Survey the limits and surface of the biointrusion barrier with choke stone in accordance with Section 02100.

### **3.04 TOLERANCE**

- A. Construct the biointrusion barrier to within -0.1 to +0.3 feet of the thickness shown on the Construction Drawings.

[END OF SECTION]

**SPECIFICATION COVER SHEET**

**SPECIFICATION SECTION:** 02605 **TITLE:** HIGH DENSITY POLYETHYLENE (HDPE) PIPES AND FITTINGS

**Specifications By:** Signature [Signature] 5 May 00  
 (Cognizant Engineer) Date  
Printed Name Michael J. Monteleone, P.E.  
and Title Senior Project Engineer

**Scope and Format**  
**Checked By:** Signature [Signature] 5 May 00  
 (Checker) Date  
Printed Name Michael J. Monteleone, P.E.  
and Title Senior Project Engineer

**Detailed Requirements**  
**Checked by:** Signature [Signature] 5 May 2000  
 (Checker) Date  
Printed Name Kwasi Badu-Tweneboah, Ph.D., P.E.  
and Title Senior Project Engineer

**Overall Review By:** Signature [Signature] 8 May 2000  
 (PDP) Date  
Printed Name J.F. Beech, Ph.D., P.E.  
and Title Principal

**Approved by:** Signature [Signature] 8 May 2000  
 (DTL) Date  
Printed Name J.F. Beech, Ph.D., P.E.  
and Title Principal

**Record of Revision (Number and initial all revisions)**

Rev. No.	Reason	Date	By	Checked	Approval
0	Certified of Construction	08 May 00		KBT	JFB

**SECTION 02605****HIGH-DENSITY POLYETHYLENE (HDPE)  
PIPES AND FITTINGS****PART 1 GENERAL****1.01 SCOPE**

- A. This Section includes high-density polyethylene (HDPE) pipes, fittings, and appurtenances.

**1.02 RELATED SECTIONS AND PLANS**

- A. Section 02100 - Surveying
- B. Section 02200 - Earthwork
- C. Section 02215 - Trenching and Backfilling
- D. Section 02710 - Granular Drainage Material
- E. Section 13005 - Liner Penetration Boxes
- F. Construction Quality Assurance (CQA) Plan
- G. Part 6 - Statement of Work
- H. Part 8 - Environmental Health & Safety/Training Requirements
- I. Part 9 - Quality Assurance Requirements

**1.03 REFERENCES**

- A. Latest version of the American Society for Testing and Materials (ASTM) Standards:
  - 1. ASTM D 638. Standard Test Method for Tensile Properties of Plastics.
  - 2. ASTM D 790. Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.
  - 3. ASTM D 1238. Standard Test Method for Flow Rates of Thermoplastics by Extrusion Plastometer.
  - 4. ASTM D 1248. Standard Specification for Polyethylene Plastics Molding and Extrusion Materials.

5. ASTM D 1505. Standard Test Method for Density of Plastics by the Density-Gradient Technique.
  6. ASTM D 1603. Standard Test Method for Carbon Black in Olefin Plastics.
  7. ASTM D 1693. Standard Test Method for Environmental Stress-Cracking of Ethylene Plastics.
  8. ASTM D 2657. Standard Practice for Heat Joining Polyolefin Pipe and Fittings.
  9. ASTM D 2837. Standard Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials.
  10. ASTM D 3350. Standard Specification for Polyethylene Plastics Pipe and Fittings Materials.
  11. ASTM F 714. Standard Specification for Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter.
  12. ASTM F 1055. Standard Specification for Electrofusion Type Polyethylene Fittings for Outside Diameter Controlled Polyethylene Pipe and Tubing.
- B. Latest version of the American National Standards Institute (ANSI) Standards:
1. ANSI B16.1. Standard Specifications for Cast-Iron Pipe Flanges and Flange Fittings.
- C. "Committee Report: Design and Installation of PE Pipe", Journal of American Water Works Association (AWWA), Vol 91, Issue 2, 1999, pp. 92-100 [AWWA, 1999].

#### 1.04 SUBMITTALS

- A. Submit the following to the Construction Manager for review within 30 calendar days from Notice to Proceed:
1. detailed shop drawings of HDPE pipes, support centralizers, electrofusion couplings, fittings, supports, and appurtenances;
  2. a list of materials to be furnished with the names of the suppliers and delivery dates of the materials to the site;
  3. procedures to be used for hydrostatic and pneumatic testing of the dual containment pipes and fittings;
  4. origin (resin supplier's name, resin production plant) and identification (brand name, number) of the polyethylene resin used;
  5. minimum Manufacturers' certifiable values and the corresponding test procedures for HDPE material properties listed in Tables 02605-1 and 02605-2; submit values that are specific to the resin used in manufacture;
  6. pipe joining equipment identification and procedures for butt-fusion welding (including recommended plate temperatures and fusion pressures) and electrofusion couplings;

7. pipe joining training plans as specified in this Section (pipe joining training shall be conducted on-site in the presence of CQC Consultant and Fluor Fernald, Inc. personnel; and shall be on the actual fusion equipment to be used for production welding); and
  8. Material Safety Data Sheet (MSDS) for HDPE.
- B. Submit to the Construction Manager for review at least 30 calendar days prior to shipment, the following documentation on the HDPE pipes, fittings, supports, and appurtenances:
1. copies of quality control certificates issued by the resin supplier including the production dates and origin of the resin used to manufacture the HDPE products for this project and to include certification that no reclaimed polymer is added to the resin during the manufacturing of the HDPE products to be used for this project; and
  2. results of tests specified in Table 02605-1 conducted by the Manufacturer to verify the quality of the resin used to manufacture the HDPE products assigned to this project.
- C. Submit to the Construction Manager for review at least 30 calendar days prior to installation of material specified in this Section, Manufacturer's written certification of compliance with this Section for that material. Include in this certification of compliance a final inspection and a written record of this inspection. The inspection shall include the following:
1. HDPE pipes, fittings, and appurtenances:
    - a. dimensional check; and
    - b. material quality check.
- D. Submit to the Construction Manager for review at least 14 calendar days prior to installation, documentation of training and certification of personnel qualified for performing HDPE pipe joining operations as specified in this Section.
- E. Submit to Construction Manager within one week after performance of work, results of all tests specified in this Section.
- F. Provide a list of equipment and other required information to install HDPE pipes and fittings in the Contractor's Earthwork Work Plan specified in Section 02200.
- G. Submit to the Construction Manager within 14 calendar days prior to HDPE pipe testing, a certificate of calibration that is less than 12 months old for pressure gauges used for pneumatic and hydrostatic pressure testing.
- H. Submit four video copies and corresponding inspection logs for video camera inspections conducted on completed LDS, LCS, and RLCS carrier pipes.

- I. Submit calibration and pressure setting documentation for the safety relief valves that will be used for pneumatic testing HDPE pipe.

#### **1.05 HEALTH AND SAFETY REQUIREMENTS**

- A. Environmental health & safety/training requirements shall be in accordance with Part 8 of the Contract Documents.

#### **1.06 CONTRACTOR'S QUALITY ASSURANCE**

- A. Contractor's quality assurance requirements shall be in accordance with Part 9 of the Contract Documents.

### **PART 2 PRODUCTS**

#### **2.01 HDPE COMPOUND**

- A. Furnish HDPE flat stock manufactured from new, high performance, high molecular weight, HDPE resin conforming to ASTM D 1248 (Type III, Class C Category 5, Grade P34), ASTM D 3350 (minimum cell classification as shown in Table 02605-1), and having a Plastic Pipe Institute (PPI) Rating of PE 3408. The resin shall be pre-compounded. In-plant blending of non-compounded resins is not permitted. Furnish material having minimum specified property values listed in Table 02605-1.
- B. Furnish only smooth HDPE flat stock with no sharp projections, homogeneous throughout with respect to resin compound, and with surfaces free of foreign inclusions and surface defects. Furnish HDPE flat stock that is as uniform as commercially practical in color, opacity, density, and other physical properties.
- C. Furnish HDPE pipe and fittings manufactured from new, high performance, high molecular weight, HDPE resin conforming to ASTM D 1248 (Type III, Class C, Category 5, Grade P34), ASTM D 3350 (minimum cell classification as shown in Table 02605-2), and having a PPI Rating of PE 3408. Furnish material having at least the minimum specified property values listed in Table 02605-2.
- D. Furnish HDPE welding rod material compatible with HDPE pipe and fittings specified in this Section.

#### **2.02 HDPE PIPES AND FITTINGS**

- A. Unless otherwise shown on the Construction Drawings, furnish HDPE pipe and fittings that have a maximum Standard Dimension Ratio (SDR) of 11 and conform to ASTM F 714.

- B. Furnish HDPE pipes in standard laying lengths of nominal 40 feet.
- C. Furnish HDPE pipes and fittings that are homogeneous throughout and free of visible cracks, holes (other than intentional manufactured perforations), foreign inclusions, or other deleterious effects, and are uniform in color, density, melt index, and other physical properties.
- D. Furnish HDPE end caps at the end of pipes as shown on the Construction Drawings.
- E. Furnish electrofusion couplings meeting the requirements of ASTM F 1055 and as recommended by the electrofusion coupling Manufacturer. Electrofusion couplings shall be used only at liner penetration boxes for LDS, LCS, and RLCS HDPE pipes as shown on Construction Drawings.
- F. For perforated pipe, perforations shall be factory drilled as shown on Construction Drawings.

### **2.03 HDPE DUAL CONTAINMENT PIPING SYSTEM**

- A. Furnish dual containment piping system consisting of field or factory fabricated carrier and containment pipes and pre-fabricated fittings.
- B. Furnish components of the dual containment piping system, including carrier piping, containment piping, fittings, and appurtenances meeting the requirements for HDPE pipes, fittings, and appurtenances specified in this Section.
- C. Furnish pipe and fittings with the carrier pipe/fitting ends extending a minimum of 6.5 inches beyond the containment pipe/fitting ends. Provide pipe in nominal lengths of 40 feet and allow for field adjustment of pipe length.
- D. Furnish pre-fabricated dual containment fittings with the carrier fitting factory installed within the containment fitting, with support centralizers installed, as shown on the Construction Drawings.
- E. Fabricate carrier to carrier and containment to containment joints using thermal butt-fusion procedures recommended by the Manufacturer and as required by this Section. Fabricate carrier to carrier joints and containment to containment joints independently of each other. Inspect carrier to carrier joints before final closure of the containment.
- F. Furnish support centralizers to provide a continuous annular space between the carrier and the containment pipes in conformance with the recommendations of the Manufacturer or with a maximum allowable spacing of 4 feet, whichever is less. Centralizers shall not inhibit flow of carrier pipe leakage in the containment pipe. Material for centralizers shall be as recommended by HDPE pipe Manufacturer.

**2.04 IDENTIFICATION**

- A. Continuously indent print on the HDPE pipe, or space at intervals not exceeding 5 feet, the following:
  - 1. name and/or trademark of the HDPE pipe Manufacturer;
  - 2. nominal HDPE pipe size;
  - 3. standard dimension ratio;
  - 4. the letters PE followed by the polyethylene grade per ASTM D 1248, followed by the Hydrostatic Design Stress in 100's of psi;
  - 5. manufacturing Standard Reference; and
  - 6. a production code from which the date and place of manufacture can be determined

**2.05 EMBEDMENT FILL AND BACKFILL MATERIALS**

- A. Furnish pipe embedment fill materials in accordance with Section 02215.
- B. Furnish backfill materials in accordance with Sections 02215.

**2.06 EQUIPMENT**

- A. Furnish equipment to install HDPE pipe, electrofusion couplings, fittings, and appurtenances.

**PART 3 EXECUTION****3.01 GENERAL**

- A. Perform HDPE pipe joining operations with trained and certified personnel. Training and certification shall be provided by pipe Manufacturer on-site prior to start of activity. Fluor Fernald, Inc. personnel and CQC Consultant shall be present during training.
- B. Liner penetration boxes shall be installed in accordance with Section 13005 prior to connection to HDPE piping.

**3.02 HANDLING OF HDPE PIPE, FITTINGS AND APPURTENANCES**

- A. Deliver HDPE pipe, fittings, and appurtenances to the site at least 10 calendar days prior to the planned installation date.
- B. Provide proper handling and storage of the HDPE pipe, fittings, and appurtenances at the site. Protect materials from excessive heat or cold, dirt, moisture, cutting, or other

damaging or deleterious conditions. Provide any additional storage procedures required by the Manufacturer.

- C. Exercise care when transporting, handling, and placing HDPE pipe and fittings. Use fabric or nylon slings and straps when handling HDPE pipe. Do not position slings, straps, etc., at butt-fusion joints or at fittings.
- D. The maximum allowable depth of cuts, gouges, or scratches on the exterior surface of HDPE pipe or fittings is 10 percent of the wall thickness. The interior of the pipe and fittings shall be free of cuts, gouges, and scratches. Replace any HDPE pipe and fittings that become gouged, twisted, or crimped. Remove damaged pipes and fittings from the project site.
- E. Whenever pipe laying is not actively in progress, close the open ends of all installed pipes using watertight plugs.

### **3.03 HDPE PIPE, FITTINGS AND APPURTENANCE INSTALLATION**

#### **A. General:**

1. Examine HDPE pipe and fittings for cracks, damage, or defects before installation. Do not use cracked, damaged, or defective material.
2. Inspect the interior of all pipe and fittings and remove any foreign material from the pipe interior before the pipe is moved into final position.
3. Perform field-cutting of pipes, where required, with a machine specifically designed for cutting pipe. Make cuts without damage to pipe, so as to leave a smooth end at right angles to the axis of pipe. Taper cut ends and smooth sharp edges. Flame cutting is not allowed.
4. Perform trenching and backfilling in accordance with Section 02215.
5. Do not lay pipe until the Construction Manager has approved the bedding conditions.
6. Install HDPE pipe and fittings in accordance with the Manufacturer's recommendations and the requirements of this Section.
7. Provide necessary adapters and/or fittings required when connecting different types and sizes of pipe or when connecting pipe made by different manufacturers.
8. Install 14-gauge insulated stranded copper wire to top of pipe as shown on the Construction Drawings and in accordance with Section 02215.
9. Install pipe and fittings to the lines and grades shown on the Construction Drawings.
10. Place and compact embedment fill and trench backfill material as shown on the Construction Drawings and in accordance with Section 02215.

- B. Install marker tape in accordance with Section 02215 and as shown on the Construction Drawings.

- C. Perform testing of installed pipe, fittings, and appurtenances in accordance with this Section.

### **3.04 HDPE PIPE JOINTS, FITTINGS, AND APPURTENANCES CONNECTIONS**

- A. Qualify personnel performing pipe joining as specified in this Section. Personnel performing pipe joining shall be trained and certified on-site with CQC Consultant and Fluor Fernald, Inc. personnel present to observe training. Training shall be conducted on the specific type of equipment that will be used during production joining operations. Electrofusion couplings shall be installed by personnel trained by the electrofusion coupling material supplier and approved by the Construction Manager.
- B. Notify the Construction Manager at least one day prior to any pipe joining to allow scheduling of monitoring by CQC Consultant. Pipe joining shall be performed in the presence of the CQC Consultant unless otherwise authorized in writing by the Construction Manager.
- C. Install electrofusion couplings at locations shown on the Construction Drawings.
- D. Weather Conditions for Joining:
  - 1. Do not join HDPE pipes and fittings at ambient temperatures below 40° Fahrenheit (F) or above 104°F, unless authorized in writing by the Construction Manager. For cold (below 40°F) or hot (above 104°F) weather joining, use the additional methods authorized in writing by the Construction Manager.
  - 2. Measure ambient temperatures at fusion machine.
  - 3. Do not join HDPE pipe and fittings during any precipitation, in the presence of heavy fog, dew, or areas of ponded water.
- E. Prior to joining, clean the joint area to be free of moisture, dust, dirt, debris of any kind, and foreign material.
- F. Fusion joining equipment shall be approved for the applicable field joining processes which are thermal butt-fusion and electrofusion. Fusion apparatus shall be automated devices equipped with gauges giving the applicable temperatures and pressures.
- G. Make trial butt-fusion joints on spool pieces of HDPE pipe to verify that joining conditions are adequate. Conduct trial joints on the same material to be installed and under similar field conditions as production joints. Conduct trial joining at the beginning of each day, and at least once each day for each fusion apparatus used that day. Also, each joiner shall make at least one trial joint each day. Conduct trial joining under the same conditions as the actual joining. Prepare trial joints that are at least 2 feet long (after joining) with the joint at the midpoint. CQC Consultant will monitor trial joining and visually check joining integrity including bead height, and that thermal

fusion equipment meets conditions recommended by the pipe Manufacturer including, but not limited to, temperature, alignment, and interfacial pressure.

- H. Join HDPE carrier and containment pipe sections using butt-fusion joining procedures unless otherwise shown on the Construction Drawings. Fabricate joints in strict compliance with ASTM D 2657, ASTM F 1055, and the Manufacturer's recommendations, and the requirements of this Section.
- I. Bolt HDPE flange adapter and Schedule 40 carbon steel lap joint flanges at the ambient temperature of the surrounding soil to prevent relaxation of the flange bolts and loosening of the joint due to thermal contraction of the polyethylene. Draw bolts up evenly and in line. Retighten bolts 1 and 4 hours after initial tightening.

### **3.05 FIELD TESTING AND INSPECTION**

- A. Notify the Construction Manager a minimum of 24 hours in advance of any pipe, including fitting and appurtenance, testing or pipe inspection. CQC Consultant will monitor pipe testing in accordance with the Construction Quality Assurance (CQA) Plan.
- B. Provide testing apparatus, including pumps, hoses, gauges with pressure relief valves, taps, plugs, drains, temporary connections, and fittings to perform testing in accordance with this Section.
- C. Test gauges shall be calibrated within one year of date of test. Calibration shall be traceable to national or industry standards where possible.
- D. HDPE Pipe and Fittings Hydrostatic Testing:
  - 1. Pressure test installed HDPE solid wall, carrier, and containment pipe with a minimum 6 inches of initial backfill placed over the containment pipe. Leave joints, fittings, and flanged connections of containment pipe uncovered so that they can be visually inspected for any leaks.
  - 2. Perform tests in the presence of the CQC Consultant and in accordance with the approved Contractor testing procedure specified in this Section. Containment pipe testing shall not proceed until carrier pipe has been successfully tested.
  - 3. Test HDPE solid wall carrier pipe at 60-psi internal pressure. Test carrier pipe in accordance with the approved Contractor's testing procedure and as specified in this Section. Containment pipe shall be at atmospheric pressure when testing carrier pipe.
  - 4. Test HDPE containment pipe at 15-psi internal pressure. Test containment pipe in accordance with the approved Contractor's testing procedure and as specified in this Section. Carrier pipe shall be at atmospheric pressure when testing containment pipe.

5. Initial expansion phase: Allow the pipe to stand at the specified internal pressure until stabilization is reached. Add sufficient make-up water to the pipe four times at one-hour intervals to return to the test pressure. Stabilization is achieved if there is no further change in pressure over a one-hour period or make-up water volume does not exceed the quantity listed in Table 02605-3. The initial expansion phase shall not exceed 4 hours.
6. Actual test phase: Start the test after the fourth addition of make-up water in the initial expansion phase. Perform test for 1, 2, or 3 hours. At the end of the test phase, add make-up water to return the pipe pressure to the test pressure. A passing test is considered to require less make-up water than listed in Table 02605-3 and no visible leaks.
7. Alternative Test: Perform initial expansion phase test at 70-psi internal pressure for carrier pipe and 25-psi internal pressure for containment pipe. Maintain test pressure over a 4-hour period as specified in this Section. Drop test pressure by 10 psi in accordance with recommendations of AWWA [1999]. If the pressure remains steady (i.e., within 5 percent of the target value), for an hour, and there are no visible leaks, passing results have been achieved..
8. Identify any leaks, remove the water, and make repairs to the pipe. Retest the pipe until passing results are achieved.

**E. HDPE Pipe and Fittings Pneumatic Testing:**

1. Final testing of all HDPE piping shall be hydrostatic.
2. Contractor may perform a preliminary low air pressure (pneumatic) testing at pressure no greater than 10 psi for HDPE piping prior to placement in the trench. Pneumatic testing shall be performed as follows:
  - a. Pressure relief valve shall be installed prior to pneumatic testing of pipe sections.
  - b. Gradually increase the pressure to one-half of the full pneumatic test pressure. Pause for 15 minutes to allow the pipe strains to become somewhat equalized and to detect any possible major leaks by means of soap bubbles or monitoring of test gauge.
  - c. Gradually increase the pressure to the full pneumatic test pressure. Hold the pressure for 15 minutes.
  - d. If the gauge pressure does not drop below the full pneumatic test pressure, and no leaks are detected, the pipe shall be considered to have passed the pressure/leak test.

**F. HDPE Pipe Inspection:**

1. Inspect fusion joints for evidence of excess or insufficient bead size, contamination, offset, or any other evidence of inadequate joining. The surface of the HDPE pipe shall be clean at the time of inspection. Wipe or wash the HDPE pipe surface if surface contamination inhibits inspection.

2. Following completion of final hydrostatic testing and placement of the protective layer, inspect the LDS, LCS, and RLCS carrier pipes using a video camera for the completed piping systems in the presence of the CQC Consultant. Provide the completed inspection video to the CQC Consultant.
3. If the inspection indicates the presence of debris in the carrier pipe, flush the pipe with water pumped through cleanout or other method approved by Construction Manager.
4. Repair any pipe sections where greater than 4 percent pipe diameter deflection from vertical is observed.

**G. Defects and Repairs:**

**1. Repair Procedures:**

- a. Repair any portion of the HDPE pipe exhibiting a flaw, or poor quality fusion joint by removing bad joint or pipe section and replacing with a new pipe section.
- b. When making repairs, satisfy the following:
  - i. clean and dry all pipe surfaces immediately prior to repair;
  - ii. only use approved fusion equipment; and
  - iii. extend repairs at least 12 inches in all direction beyond the extent of the defect.

**2. Repair Verification:**

- a. Inspect each repair using the methods described in this Section.

**3.06 CONSTRUCTION QUALITY REQUIREMENTS**

- A. CQC Consultant will monitor HDPE pipe joining and performance testing to establish compliance with this Section and in accordance with the CQA Plan.
- B. If the performance testing and confirmation of compliance indicates that any portion of the work does not meet the requirements of this Section, CQC Consultant will delineate the extent of the non-conforming work.

**3.07 SURVEY CONTROL**

- A. Survey location and elevation of the HDPE pipe and appurtenances in accordance with Section 02100.
- B. Survey the top of HDPE containment pipe on no greater than 25-foot centers and at liner penetration boxes in accordance with Section 02100.
- C. Provide a "redline" drawing showing location of electrofusion couplings.

**3.08 TOLERANCES**

- A. Install HDPE pipes to within  $\pm 0.1$  feet of bottom of pipe elevations of the containment pipes as indicated on the Construction Drawings.
- B. Provide positive slope of gravity lines at all locations to within  $\pm 10$  percent of the value indicated on the Construction Drawings.

FOR THE USE OF THE CONTRACTOR TO BE DETERMINED BY THE CONTRACTOR

TABLE 02605-1

**REQUIRED HDPE FLAT STOCK PROPERTIES  
ASTM D 3350 CELL CLASSIFICATION PROPERTIES AND RANGES**

Properties	Cell Classification	Qualifiers	Units	Specified Property Values	Test Method
Density	3	Minimum	g/cm <sup>3</sup>	0.94	ASTM D 1505
Melt Flow Index	3 to 5	Maximum	g/10 min	<0.4	ASTM D 1238 (Condition E)
Flexural Modulus	5	Minimum	lb/in <sup>2</sup>	110,000	ASTM D 790
Tensile Strength	4 or 5	Minimum	lb/in <sup>2</sup>	3,000	ASTM D 638
Environmental Stress Crack	3	Minimum	hrs	F <sub>20</sub> > 192	ASTM D 1693
Hydrostatic Design Basis at 73°F	4	Minimum	lb/in <sup>2</sup>	1,600	ASSTM D 2837
UV Stabilizer	C	Minimum	% Carbon Black	2	ASTM D 1603

**TABLE 02605-2**  
**REQUIRED PROPERTIES AND RANGES**  
**HDPE PIPE AND FITTINGS**

Properties	Cell Classification	Qualifiers	Units	Specified Property Values	Test Method
Density	3	Minimum	g/cm <sup>3</sup>	0.941	ASTM D 1505
Melt Flow Index	4	Maximum	g/10 min	0.15	ASTM D 1238 (Condition E 190/2.16)
	or 5	Range	g/10 min	0.15 to 4.0	ASTM D 1238 (Condition F 190/2.16)
Flexural Modulus	5	Minimum	lb/in <sup>2</sup>	110,000	ASTM D 790
Tensile Strength	4	Minimum	lb/in <sup>2</sup>	3,000	ASTM D 638
Environmental Stress Crack	3	Minimum	hrs	F <sub>20</sub> > 192	ASTM D 1693
Hydrostatic Design Basis at 73°F	4	Minimum	lb/in <sup>2</sup>	1,600	ASSTM D 2837
UV Stabilizer	C	Minimum	% Carbon Black	2	ASTM D 1603

TABLE 02605-3

**ALLOWANCE\* FOR EXPANSION  
UNDER TEST PRESSURE FOR AMBIENT CONDITIONS+  
Allowance for Expansion  
(U.S. Gallons / 100 Feet of Pipe)**

Nominal Pipe Size (Inches)	1 Hour Test	2 Hour Test	3 Hour Test
3	0.10	0.15	0.25
4	0.13	0.25	0.40
6	0.30	0.60	0.90
8	0.50	1.0	1.5
10	0.75	1.30	2.10
11	1.0	2.0	3.0
12	1.1	2.3	3.4
14	1.4	2.8	4.2
16	1.7	3.3	5.0
18	2.2	4.3	6.5
20	2.8	5.5	8.0
22	3.5	7.0	10.5
24	4.5	8.9	13.3
28	5.5	11.1	16.8
32	7.0	14.3	21.5
36	9.0	18.0	27.0
40	11.0	22.0	33.0
48	15.0	27.0	43.0

\*These allowances only apply to the actual test phase and not to the initial expansion phase. They also assume pipe is being tested at a maximum design pressure equal to 1.5 times the pressure rating. If the pipe is being tested at a lower system design pressure, the allowance should be reduced by the ratio of the system design pressure to the maximum design pressure.

+When testing at temperatures below ambient (approximately 75°F), less pipe expansion takes place, resulting in lower requirements for make-up water. For a test temperature of about 68°F, the values in this table should be multiplied by a reduction factor of 0.75. For 50°F, this factor is 0.50.

The above footnotes are in accordance with the recommendation of AWWA [1999].

[END OF SECTION]

**SPECIFICATION COVER SHEET**

**SPECIFICATION SECTION:** 02710 **TITLE:** GRANULAR DRAINAGE MATERIAL

**Specifications By:** Signature [Signature] 5 May 00  
 (Cognizant Engineer) Date

Printed Name Michael J. Monteleone, P.E.  
and Title Senior Project Engineer

**Scope and Format**

**Checked By:** Signature [Signature] 5 May 00  
 (Checker) Date

Printed Name Michael J. Monteleone, P.E.  
and Title Senior Project Engineer

**Detailed Requirements**

**Checked by:** Signature [Signature] 5 May 2000  
 (Checker) Date

Printed Name Kwasi Badu-Tweneboah, Ph.D., P.E.  
and Title Senior Project Engineer

**Overall Review By:** Signature [Signature] 8 May 2000  
 (PDP) Date

Printed Name J.F. Beech, Ph.D., P.E.  
and Title Principal

**Approved by:** Signature [Signature] 8 May 2000  
 (DTL) Date

Printed Name J.F. Beech, Ph.D., P.E.  
and Title Principal

**Record of Revision (Number and initial all revisions)**

Rev. No.	Reason	Date	By	Checked	Approval
0	Certified for Construction	08 May 00		EBT	

**SECTION 02710****GRANULAR DRAINAGE MATERIAL****PART 1 GENERAL****1.01 SCOPE**

- A. This Section includes granular drainage material and placement.

**1.02 RELATED SECTIONS AND PLANS**

- A. Section 02100 - Surveying
- B. Section 02200 - Earthwork
- C. Section 02714 - Geotextiles
- D. Construction Quality Assurance (CQA) Plan
- E. Part 6 - Statement of Work
- F. Part 8 - Environmental Health & Safety/Training Requirements
- G. Part 9 - Quality Assurance Requirements

**1.03 REFERENCES**

- A. Latest version of American Association of State Highway and Transportation Officials (AASHTO) Standard:
1. AASHTO M 43. Standard Specification for Standard Sizes of Coarse Aggregates for Highway Construction.
- B. Latest version of American Society for Testing and Materials (ASTM) Standards:
1. ASTM C 136. Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
  2. ASTM D 2434. Standard Test Method for Permeability of Granular Soils (Constant Head).
  3. ASTM D 2487. Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System).
  4. ASTM D 3042. Standard Test Method for Insoluble Residue in Carbonate Aggregate.

- C. *“Off-Site Borrow Materials Geotechnical Evaluation Report”* [Parsons, 1996]. This report presents geotechnical data for potential off-site borrow sources for On-Site Disposal Facility (OSDF) construction materials, including fine concrete aggregates (sand), coarse concrete aggregates (gravel), pea gravel, and riprap.

#### 1.04 SUBMITTALS

- A. For each source of granular drainage material, submit the following to the Construction Manager for review within 30 calendar days from Notice to Proceed:
1. source of the granular drainage material;
  2. certification and test results from the supplier that the granular drainage material meets the material requirements of this Section; certification shall also include that tests were performed in accordance with ASTM C 136, ASTM D 2434, ASTM D 2487, and ASTM D 3042 on granular drainage material from each source; and
  3. a 50-pound representative sample of granular drainage material from each source, for visual examination, and testing, if necessary.
- B. Provide a list of equipment, description of construction method, and other required information for placement of granular drainage material in the Contractor's Earthwork Work Plan specified in Section 02200.

#### 1.05 HEALTH AND SAFETY REQUIREMENTS

- A. Environmental health & safety/training requirements shall be in accordance with Part 8 of the Contract Documents.

#### 1.06 CONTRACTOR'S QUALITY ASSURANCE

- A. Contractor's quality assurance requirements shall be in accordance with Part 9 of the Contract Documents.

### PART 2 PRODUCTS

#### 2.01 MATERIALS

- A. Granular drainage material shall consist of homogeneous crushed or angular material that is free of deleterious materials.
- B. Granular drainage material for the leachate collection system (LCS) drainage layer, leak detection system (LDS) drainage layer, protective layer in the Impacted Runoff Catchment Area, and cover drainage layer, shall be classified as GP in accordance with the Unified Soil Classification System per ASTM D 2487, and shall meet the AASHTO

M 43 gradation requirements for No. 78 coarse aggregate. Sieve analysis for this coarse aggregate shall be performed in accordance with ASTM C 136.

- C. Percentage of granular drainage material passing the No. 200 sieve for the LCS drainage layer, LDS drainage layer, cover drainage layer, and the protective layer in the Impacted Runoff Catchment Area shall be less than 2 percent by weight when tested in accordance with ASTM C 136.
- D. Granular drainage material for the LCS drainage layer, LDS drainage layer, cover drainage layer, and the protective layer in the Impacted Runoff Catchment Area shall have a minimum hydraulic conductivity of  $1 \times 10^{-1}$  centimeters per second (cm/s) based on laboratory permeability testing conducted in accordance with ASTM D 2434.
- E. Granular drainage material for the LCS and LDS drainage corridors shall be classified as GP in accordance with the Unified Soil Classification System (per ASTM D 2487), and shall meet the AASHTO M 43 gradation requirements for No. 57 coarse aggregate. Sieve analysis for this coarse aggregate shall be performed in accordance with ASTM C 136.
- F. Percentage of granular drainage material passing No. 200 sieve for the LCS and LDS drainage corridors shall be less than 2 percent by weight when tested in accordance with ASTM C 136.
- G. Granular drainage material for the LCS and LDS drainage corridors shall have a minimum hydraulic conductivity of 10 cm/s based on laboratory permeability testing conducted in accordance with ASTM D 2434.
- H. Granular drainage material for the LCS and LDS drainage layers, LCS and LDS drainage corridors, and cover drainage layer shall have less than 5 percent loss of weight, when tested at a pH of 4 instead of the pH specified in ASTM D 3042.

## 2.02 EQUIPMENT

- A. Furnish equipment to haul, place, spread, and compact granular drainage materials.

## PART 3 EXECUTION

### 3.01 MATERIAL PLACEMENT

- A. Do not commence placement of the granular drainage material until the CQC Consultant has completed conformance testing and confirmation of compliance of the granular drainage materials and performance testing of underlying layers, including

acceptance of the Contractor's survey results for underlying layers as specified in Section 02100.

- B. Construct the granular drainage material to the thickness and limits shown on the Construction Drawings.
- C. Place the granular drainage material directly on top of the geotextile cushion, and/or the supplemental geotextile cushion, as shown on the Construction Drawings. Do not dump granular drainage material directly on the geotextile. Place the granular drainage material by dumping onto previously placed granular drainage material and then carefully spread using low ground-pressure equipment meeting the ground pressure requirements of Section 02714.
- D. Spread granular drainage material over the geotextile to cause the material to cascade over the geotextile rather than be shoved across the geotextile.
- E. Do not drive equipment directly on the geotextile cushion or supplemental cushion. Only use equipment to place, spread, and compact the granular drainage material that meets the ground pressure requirements of Section 02714.
- F. Place the granular drainage material in one loose lift.
- G. Compact the granular drainage material with one pass of equipment that meets the ground pressure requirements of Section 02714. Use portable compactors in constricted locations and adjacent to structures.
- H. Dust control shall be in accordance with Part 6 of the Contract Documents.

### **3.02 CONSTRUCTION QUALITY REQUIREMENTS**

- A. The CQC Consultant will perform conformance testing on the granular drainage material to confirm compliance with this Section. The conformance testing requirements and the minimum testing frequencies shall be in accordance with the Construction Quality Assurance (CQA) Plan.
- B. CQC Consultant will monitor the granular drainage material placement in accordance with this Section and the CQA Plan.

### **3.03 SURVEY CONTROL**

- A. Survey and verify the surface limits and thickness of the granular drainage material layers in accordance with Section 02100.

**3.04 TOLERANCES**

- A. Construct the LDS drainage layer, LDS drainage corridor, LCS drainage layer, and LCS drainage corridor to within 0.0 to +0.1 feet of the thicknesses indicated on the Construction Drawings.
- B. Construct the cover drainage layer to within 0.0 to +0.1 feet of the thicknesses shown on the Construction Drawings.

[END OF SECTION]

**SPECIFICATION COVER SHEET**

**SPECIFICATION SECTION:** 02712 **TITLE:** GRANULAR FILTER MATERIAL

**Specifications By:** (Cognizant Engineer)  
 Signature *[Signature]* 5 May 00  
 Date  
 Printed Name Michael J. Monteleone, P.E.  
 and Title Senior Project Engineer

**Scope and Format**  
**Checked By:** (Checker)  
 Signature *[Signature]* 5 May 00  
 Date  
 Printed Name Michael J. Monteleone, P.E.  
 and Title Senior Project Engineer

**Detailed Requirements**  
**Checked by:** (Checker)  
 Signature *[Signature]* 5 May 2000  
 Date  
 Printed Name Kwasi Badu-Tweneboah, Ph.D., P.E.  
 and Title Senior Project Engineer

**Overall Review By:** (PDP)  
 Signature *[Signature]* 8 May 2000  
 Date  
 Printed Name J.F. Beech, Ph.D., P.E.  
 and Title Principal

**Approved by:** (DTL)  
 Signature *[Signature]* 8 May 2000  
 Date  
 Printed Name J.F. Beech, Ph.D., P.E.  
 and Title Principal

**Record of Revision (Number and initial all revisions)**

Rev. No.	Reason	Date	By	Checked	Approval
0	Certified for Construction	08 May 00		LCBT	JFB

**SECTION 02712****GRANULAR FILTER MATERIAL****PART 1 GENERAL****1.01 SCOPE**

- A. This Section includes granular filter materials and placement.

**1.02 RELATED SECTIONS AND PLANS**

- A. Section 02100 - Surveying
- B. Section 02200 - Earthwork
- C. Section 02280 - Biointrusion Barrier
- D. Construction Quality Assurance (CQA) Plan
- E. Part 6 - Statement of Work
- F. Part 8 - Environmental Health & Safety/Training Requirements
- G. Part 9 - Quality Assurance Requirements

**1.03 REFERENCES**

- A. Latest version of American Society for Testing and Materials (ASTM) Standards:
  - 1. ASTM C 136. Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
- B. *"Off-Site Borrow Materials Geotechnical Evaluation Report"* [Parsons, 1996]. This report presents geotechnical data for potential off-site borrow sources for On-Site Disposal Facility (OSDF) construction materials, including fine concrete aggregate (sand), coarse concrete aggregates (gravel), pea gravel, and riprap.
- C. Latest version of Ohio Department of Transportation Construction and Material Specifications (Ohio DOT Specifications).

**1.04 SUBMITTALS**

- A. For each source of granular filter material, submit the following to the Construction Manager for review within 30 calendar days from Notice to Proceed:
  - 1. the source of the granular filter material;
  - 2. certification and test results from the supplier that the granular filter material meets the requirements of this Section; certification shall also include that tests were performed in accordance with ASTM C 136 on granular filter material; and
  - 3. 50-pound representative sample of the granular filter material from each source for visual examination, and testing, if necessary.
- B. Provide list of equipment, description of construction methods, and other required information for placement of granular filter material in the Contractor's Earthwork Work Plan specified in Section 02200.

**1.05 HEALTH AND SAFETY REQUIREMENTS**

- A. Environmental health & safety/training requirements shall be in accordance with Part 8 of the Contract Documents.

**1.06 CONTRACTOR'S QUALITY ASSURANCE**

- A. Contractor's quality assurance requirements shall be in accordance with Part 9 of the Contract Documents.

**PART 2 PRODUCTS****2.01 MATERIALS**

- A. Granular filter material shall consist of natural sand material meeting the gradation requirements of Section 703.06 of the Ohio DOT Specifications. Gradation testing shall be in accordance with ASTM C 136.

**2.02 EQUIPMENT**

- A. Furnish equipment to haul, place, spread, and compact granular filter material.

**PART 3 EXECUTION****3.01 PLACEMENT**

- A. Do not place granular filter material until CQC Consultant has completed conformance testing and confirmation of compliance of the granular filter material and performance testing of underlying layers, including acceptance of the Contractor's survey results for underlying layers as specified in Section 02100.
- B. Construct the granular filter material to the thickness and limits shown on the Construction Drawings.
- C. Place the granular filter material directly on the biointrusion barrier choke stone constructed in accordance with Section 02280.
- D. Place the granular filter material in one loose lift.
- E. Compact the granular filter material during placement by tracking with a bulldozer or other equipment approved by the Construction Manager. Compact with at least two passes of the specified or approved compaction equipment. Use portable compaction equipment in constricted locations and adjacent to structures.
- F. Dust control shall be in accordance with Part 6 of the Contract Documents.

**3.02 CONSTRUCTION QUALITY REQUIREMENTS**

- A. CQC Consultant will perform conformance testing on the granular filter material to confirm compliance with this Section. Conformance testing to be performed and the minimum testing frequencies shall be in accordance with the Construction Quality Assurance (CQA) Plan.
- B. CQC Consultant will monitor granular filter material construction in accordance with this Section and the CQA Plan.

**3.03 SURVEY CONTROL**

- A. Survey the limits, thickness, and surface of the granular filter material in accordance with Section 02100.

**3.04 TOLERANCE**

- A. Construct the granular filter to within 0.0 to  $\pm 0.1$  feet of the thickness shown on the Construction Drawings.

[END OF SECTION]

INSERT

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**SECTION 02714****GEOTEXTILES****PART 1 GENERAL****1.01 SCOPE**

- A. This Section includes materials and installation for geotextiles.
- B. Quantity of geotextile materials to be furnished by Fluor Fernald, Inc. will be as specified in Part 6 of the Contract Documents. Additional required geotextile materials, shall be furnished by the Contractor.

**1.02 RELATED SECTIONS AND PLANS**

- A. Section 02200 - Earthwork
- B. Section 02215 - Trenching and Backfilling
- C. Section 02230 - Road Construction
- D. Section 02271 - Riprap
- E. Construction Quality Assurance (CQA)
- F. Part 6 - Statement of Work
- G. Part 8 - Environmental Health & Safety/Training Requirements
- H. Part 9 - Quality Assurance Requirements

**1.03 REFERENCES**

- A. Latest version of American Society for Testing and Materials (ASTM) Standards:
  - 1. ASTM D 3786. Standard Test Method for Hydraulic Bursting Strength of Knitted Goods and Nonwoven Fabric-Diaphragm Bursting Strength Test Method.
  - 2. ASTM D 4355. Standard Test Method for Deterioration of Geotextiles from Exposure to Ultraviolet Light and Water (Xenon-ARC type apparatus).

3. ASTM D 4491 Standard Test Method for Water Permeability of Geotextiles by Permittivity.
4. ASTM D 4533. Standard Test Method for Trapezoid Tearing Strength of Geotextiles.
5. ASTM D 4632. Standard Test Method for Breaking Load and Elongation of Geotextiles (Grab Method).
6. ASTM D 4751. Standard Test Method for Determining Apparent Opening Size of a Geotextile.
7. ASTM D 4833. Standard Test Method for Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products.
8. ASTM D 4873. Standard Guide for Identification, Storage, and Handling of Geotextiles.
9. ASTM D 5261. Standard Test Method for Measuring Mass Per Unit Area of Geotextiles.

B. Federal Standard No. 751a - Stitches, Seams, and Stitching.

#### **1.04 SUBMITTALS**

- A. Submit to the Construction Manager a letter of acceptance for the quantity of geotextile materials furnished by Fluor Fernald, Inc. Quantity of geotextile materials stored on site shall be inspected, inventoried, and accepted within 30 calendar days of Notice to Proceed.
- B. For geotextiles furnished by Contractor, submit the following to Construction Manager for review within 30 calendar days from Notice to Proceed:
  1. product name;
  2. geotextile manufacturing capabilities, including;
    - a. daily production capacity available for this Contract; and
    - b. manufacturing quality control procedures;
  3. certification of minimum average roll values 95 percent lower confidence limits and the corresponding test procedures for all geotextile properties listed in Tables 02714-1 to 02714-5;
  4. projected geotextile delivery dates; and
  5. recommended long-term storage requirements.
- C. For geotextiles furnished by Contractor, submit to Construction Manager for review at least 14 calendar days prior to transporting geotextile to the site, manufacturing quality control certificates signed by the quality control manager applicable to each roll of geotextile as specified in this Section. The submittal shall include a list of roll numbers to be shipped indicating which rolls were sampled and tested. The certificates shall

state that the geotextiles are continuously inspected and are needle-free. The quality control certificates shall also include:

1. lot, roll numbers, and other identification;
2. sampling procedures; and
6. results of quality control tests, including descriptions of test methods used (the Manufacturer quality control tests to be performed are specified in this Section).

- D. Provide list of equipment, description of installation methods storage methods in accordance with manufacturer's recommendation, and other required information related to the installation of geotextile in the Earthwork Work Plan specified in Section 02200.

### **1.05 HEALTH AND SAFETY REQUIREMENTS**

- A. Environmental health & safety/training requirements shall be in accordance with Part 8 of the Contract Documents.

### **1.06 CONTRACTOR'S QUALITY ASSURANCE**

- A. Contractor's quality assurance requirements shall be in accordance with Part 9 of the Contract Documents.

## **PART 2 PRODUCTS**

### **2.01 GEOTEXTILE**

- A. Geotextile materials furnished by Fluor Fernald, Inc. will meet the following requirements:
1. minimum average roll values with 95 percent lower confidence limits meeting or exceeding the required property values specified in Tables 02714-1 for geotextile filters and sacrificial geotextile filters, 02714-2 for geotextile cushion in final cover system, 02714-3 for geotextile cushion in liner system, 02714-4 for supplemental geotextile cushion in liner system, and 02714-5 for geotextile separator; and
  2. manufactured from first quality polymers, with not more than 20 percent reclaimed polymer used in production.
- B. Geotextiles furnished by Contractor shall meet or exceed the required property values specified in Tables 02714-1 through 02714-5. Geotextiles shall be manufactured from first quality polymers with not more than 20 percent reclaimed polymer used in production.

- C. Furnish polymeric threads for stitching that are ultra-violet (UV) light stabilized to at least the same requirements as the geotextile to be sewn. Threads shall be polyester or polypropylene threads that have a minimum size of 2,000 denier.

**2.02 MANUFACTURING QUALITY CONTROL**

- A. For geotextile furnished by Contractor, sample and test the geotextile to demonstrate that the material conforms to the requirements of this Section. Do not supply any geotextile roll that does not comply with the manufacturing quality control requirements.
  - 1. Perform manufacturing quality control tests to demonstrate that properties conform to the values specified in Tables 02714-1 to 02714-5. Perform the following manufacturing quality control tests at a maximum interval of one test for each 50,000 square feet manufactured. All tested rolls of material used to certify compliance shall be delivered to the site. Test data for rolls not delivered to the site will not be accepted.

<u>Test</u>	<u>Procedure</u>
Mass per unit area	ASTM D 5261
Grab strength	ASTM D 4632
Tear strength	ASTM D 4533
Puncture strength	ASTM D 4833
Burst strength	ASTM D 3786

- 2. Perform additional manufacturing quality control tests on geotextile filter properties only, at a maximum interval of one test for each 100,000 square feet manufactured to demonstrate that its apparent opening size (ASTM D 4751) and permittivity (ASTM D 4491) conform to the values specified in Table 02714-1. All tested rolls of material used to certify compliance shall be delivered to the site. Test data for rolls not delivered to the site will not be accepted.
- B. For geotextile furnished by Contractor, if a geotextile sample fails to meet the quality control requirements of this Section, sample and test rolls manufactured at the same time and in the same lot as the failing roll. Continue to sample and test the rolls until the extent of the failing rolls are bracketed by passing rolls. Do not supply failing rolls.

**2.03 PACKAGING**

- A. Geotextiles rolls will be wrapped in relatively impermeable and opaque protective covers.
- B. Covers which become torn or damaged shall be repaired by the Contractor with similar materials.
- C. Geotextile rolls will be marked or tagged in accordance with ASTM D 4873 with the following information:
  - 1. Manufacturer's name;
  - 2. product identification;
  - 3. lot or batch number;
  - 4. roll number; and
  - 5. roll dimensions.
- D. Geotextile rolls not labeled in accordance with this Section or on which labels are illegible shall be rejected and replaced. The Contractor shall notify the Construction Manager of any rolls not labeled in accordance with the Section.
- E. The minimum size of each lot for geotextile furnished by the Contractor and delivered to the Site will be 100,000 ft<sup>2</sup>.

**2.04 SHIPPING**

- A. Geotextiles furnished by Contractor, shall not be shipped prior to final review and confirmation of compliance of Manufacturer's quality control submittals specified in this Section and conformance testing specified in the CQA Plan and by the Consultant

**2.05 ACCEPTANCE, HANDLING, AND STORAGE**

- A. Upon delivery to the project site, Contractor shall inspect and inventory the geotextile materials and the manner in which they are stored. Contractor shall also inspect geotextile material stockpiled at the OSDF. Contractor shall provide to the Construction Manager with a written letter of acceptance within 30 calendar days if material is acceptable for installation. Contractor shall also notify the Construction Manager in writing within 30 calendar days of any geotextile material that is not acceptable for installation.
- B. Protection and preservation of geotextile material shall include, but not be limited to:
  - 1. protection from sunlight, moisture, excessive heat or cold, puncture, mud, dirt, and dust or other damaging conditions; follow geotextile Manufacturer recommenda-

- tions for handling and storage; Manufacturer recommendations will be provided by the Construction Manager for geotextile furnished by Fluor Fernald, Inc.; and
2. storage of rolls on pallets, or other elevated structures; do not store rolls directly on the ground.
- C. Contractor shall unload, handle and store geotextile material furnished by Fluor Fernald, Inc. and by Contractor. Handling shall be performed such that damage to geotextile materials does not occur.

## **2.06 EQUIPMENT**

- A. Furnish equipment for acceptance, handling, storage, and installation of geotextile.

## **PART 3 EXECUTION**

### **3.01 PLACEMENT**

- A. Do not commence geotextile installation until the CQC Consultant completes performance testing and confirmation of compliance of underlying layers, including acceptance of Contractor's survey results for underlying layers.
- B. Handle geotextiles so as to ensure they are not damaged.
- C. Take precautions to prevent damage to underlying layers.
- D. After unwrapping the geotextiles from their opaque covers, do not leave them exposed for a period in excess of 10 calendar days or for the Manufacturer's written recommended exposure period.
- E. If white colored geotextiles are used, take appropriate safety precautions against "snowblindness" of personnel.
- F. Take care not to entrap stones, excessive dust, or moisture below or in the geotextiles.
- G. Examine the geotextile surface after installation to ensure that no potentially harmful foreign objects are present. Remove any such objects and replace any damaged geotextiles.

**3.02 SEAMS AND OVERLAPS**

- A. Continuously overlap a minimum of 6 inches and sew geotextile filters, cushions, and supplemental geotextile cushions using a "single prayer" seam. Sew seams using Stitch Type 401 as per Federal Standard No. 751a. Spot sewing will not be allowed.
- B. Do not install horizontal seams on slopes that are steeper than 10 horizontal to 1 vertical (10H:1V). Seams shall be along, not across, the slopes.
- C. Overlap geotextile separator a minimum of 12 inches and spot sew at intervals to ensure that the overlap is maintained.
- D. Overlap geotextile filter used for riprap construction in Section 02271 a minimum of 12 inches. No seaming is required.

**3.03 REPAIR**

- A. Repair holes or tears in the geotextiles using a patch made from the same geotextile material. Extend geotextile patches a minimum of 1 foot beyond the damaged area. Sew geotextile patches into place no closer than 1 inch from panel edge. Should tear exceed 50 percent of the width of the panel, cut across the entire width of the panel and seam as an end seam. For slope areas steeper than 10H:1V, tears exceeding 50 percent of the width of the panel shall be removed and replaced.
- B. Remove any soil or other material that may have penetrated the torn geotextiles.

**3.04 CREST ANCHORAGE SYSTEM**

- A. Install the geotextile along with the other geosynthetic layers in the anchor trench and wedge at the crest of the slope as shown on the Construction Drawings. Temporarily anchor the geosynthetic layers using sandbags or other means until the commencement of trench backfilling. Do not place geotextiles in anchor trench if standing water is present.
- B. Do not entrap soil, sand bags, excessive moisture, or other materials below or between the geosynthetic layers in the anchor trench.
- C. Backfill the anchor trench with compacted clay liner once all the geosynthetic layers are installed in the anchor trench. Backfill to the limits shown on the Construction Drawings. Compact backfill in accordance with Section 02215.
- D. Do not damage exposed geosynthetic layer when backfilling the anchor trench.

- E. Do not place granular drainage material for the leak detection system or leachate collection system on the side slopes until after the anchor trenches are completely backfilled unless authorized in writing by the Construction Manager.

**3.05 PLACEMENT OF SOIL AND AGGREGATE MATERIALS**

- A. Place soil materials on top of geotextiles in such a manner as to ensure that:
  1. the geotextiles and the underlying materials are not damaged; and
  2. slippage does not occur between the geotextile and the underlying layers during placement.
- B. Spread soil on top of the geotextile to cause the soil to cascade onto the geotextile rather than be shoved across the geotextile.
- C. For geotextile cushions overlying the geomembrane, do not place granular drainage material at ambient temperatures below 40 degrees Fahrenheit (°F) or above 104°F. For placement of granular drainage material below 40°F and above 104°F, Contractor shall submit placement methods to the Construction Manager for review and approval.
- D. Do not drive equipment directly on the geotextile. Only use equipment above a geotextile cushion overlying a geomembrane that meets the following ground pressure requirements:

Maximum Allowable Equipment Ground Pressure (pounds per square inch)	Minimum Thickness of Overlying Fill or Aggregate Layer (inches)
less than 5	12 (see note 1)
less than 10	18
less than 20	24
greater than 20	36

Note 1: Minimum thickness of first loose lift of the clay liner material for the protective clay layer shall be a 10-inch ±1-inch.

- E. Place aggregate over geotextile separator as shown on the Construction Drawings prior to trafficking in accordance with Section 02230.

- F. Place soil over geotextile filters as shown on the Construction Drawings prior to trafficking.

### 3.06 CONSTRUCTION QUALITY REQUIREMENTS

- A. CQC Consultant will perform conformance testing on the geotextile materials furnished by Contractor to establish compliance with this Section. Conformance testing and minimum frequencies shall be in accordance with the Construction Quality Assurance (CQA) Plan.
- B. CQC Consultant will monitor the geotextile installation in accordance with this Section and CQA Plan.

**TABLE 02714-1**  
**REQUIRED PROPERTY VALUES FOR GEOTEXTILE FILTER AND**  
**SACRIFICIAL GEOTEXTILE FILTER**

<b>PROPERTIES</b>	<b>QUALIFIER</b>	<b>UNITS<sup>(5)</sup></b>	<b>SPECIFIED<sup>(4)</sup> PROPERTY VALUES</b>	<b>TEST METHOD</b>
<b><u>Identification Requirements</u></b>				
Type	(-)	(-)	Nonwoven needlepunched	(-)
Polymer composition	minimum	%	95 polypropylene or polyester by weight	(-)
Mass per unit area	minimum	oz/yd <sup>2</sup>	7	ASTM D 5261
<b><u>Filter Requirements</u></b>				
Apparent opening size (O <sub>95</sub> )	maximum	mm	0.212	ASTM D 4751
Permittivity	minimum	sec <sup>-1</sup>	0.5	ASTM D 4491
<b><u>Mechanical Requirements</u></b>				
Grab strength	minimum	lb	180	ASTM D 4632 <sup>(1)</sup>
Tear strength	minimum	lb	75	ASTM D 4533 <sup>(2)</sup>
Puncture strength	minimum	lb	75	ASTM D 4833 <sup>(3)</sup>
Burst strength	minimum	psi	350	ASTM D 3786
<b><u>Durability Requirements</u></b>				
Ultraviolet Resistance	minimum	%	70	ASTM D 4355

**Notes:**

- (1) Minimum of values measured in machine and cross machine directions with 1 inch clamp on Constant Rate of Extension (CRE) machine.
- (2) Minimum value measured in machine and cross machine direction.
- (3) Tension testing machine with a 1.75-inch diameter ring clamp, the steel ball being replaced with 0.31-inch diameter solid steel cylinder with flat tip centered within the ring clamp.
- (4) All values represent minimum average roll values.
- (5) mm = millimeter  
% = percent  
oz/yd<sup>2</sup> = ounce per square yard  
sec = second  
lb = pound  
psi = pound per square inch

TABLE 02714-2

**REQUIRED PROPERTY VALUES FOR GEOTEXTILE CUSHION  
IN FINAL COVER SYSTEM**

PROPERTIES	QUALIFIER	UNITS <sup>(5)</sup>	SPECIFIED <sup>(4)</sup> PROPERTY VALUES	TEST METHOD
<u>Identification Requirements</u>				
Type	(-)	(-)	Nonwoven needlepunched	(-)
Polymer composition	minimum	%	95 polypropylene or polyester by weight	(-)
Mass per unit area	minimum	oz/yd <sup>2</sup>	8	ASTM D 5261
<u>Mechanical Requirements</u>				
Grab strength	minimum	lb	200	ASTM D 4632 <sup>(1)</sup>
Tear strength	minimum	lb	75	ASTM D 4533 <sup>(2)</sup>
Puncture strength	minimum	lb	90	ASTM D 4833 <sup>(3)</sup>
Burst strength	minimum	psi	350	ASTM D 3786
<u>Durability Requirements</u>				
Ultraviolet Resistance	minimum	%	70	ASTM D 4355

## Notes:

- (1) Minimum of values measured in machine and cross machine directions with 1 inch clamp on Constant Rate of Extension (CRE) machine.
- (2) Minimum value measured in machine and cross machine direction.
- (3) Tension testing machine with a 1.75-inch diameter ring clamp, the steel ball being replaced with 0.31-inch diameter solid steel cylinder with flat tip centered within the ring clamp.
- (4) All values represent minimum average roll values.
- (5) mm = millimeter  
% = percent  
oz/yd<sup>2</sup> = ounce per square yard  
sec = second  
lb = pound  
psi = pound per square inch

**TABLE 02714-3**  
**REQUIRED PROPERTY VALUES FOR GEOTEXTILE CUSHION**  
**IN LINER SYSTEM**

PROPERTIES	QUALIFIER	UNITS <sup>(9)</sup>	SPECIFIED <sup>(6)</sup> PROPERTY VALUES	TEST METHOD
<u>Identification Requirements</u>				
Type	(-)	(-)	Nonwoven needlepunched	(-)
Polymer composition	minimum	%	95 polypropylene or polyester by weight	(-)
Mass per unit area	minimum	oz/yd <sup>2</sup>	10	ASTM D 5261
<u>Mechanical Requirements</u>				
Grab strength	minimum	lb	225	ASTM D 4632 <sup>(1)</sup>
Tear strength	minimum	lb	90	ASTM D 4533 <sup>(2)</sup>
Puncture strength	minimum	lb	120	ASTM D 4833 <sup>(3)</sup>
Burst strength	minimum	psi	450	ASTM D 3786
<u>Durability Requirements</u>				
Ultraviolet Resistance	minimum	%	70	ASTM D 4355

Notes:

- (1) Minimum of values measured in machine and cross machine directions with 1 inch clamp on Constant Rate of Extension (CRE) machine.
- (2) Minimum value measured in machine and cross machine direction.
- (3) Tension testing machine with a 1.75-inch diameter ring clamp, the steel ball being replaced with 0.31-inch diameter solid steel cylinder with flat tip centered within the ring clamp.
- (4) All values represent minimum average roll values.
- (5) mm = millimeter  
% = percent  
oz/yd<sup>2</sup> = ounce per square yard  
sec = second  
lb = pound  
psi = pound per square inch

TABLE 02714-4

REQUIRED PROPERTY VALUES FOR SUPPLEMENTAL  
GEOTEXTILE CUSHION IN LINER SYSTEM

PROPERTIES	QUALIFIER	UNITS <sup>(5)</sup>	SPECIFIED <sup>(1)</sup> PROPERTY VALUES	TEST METHOD
<u>Identification Requirements</u>				
Type	(-)	(-)	Nonwoven needlepunched	(-)
Polymer composition	minimum	%	95 polypropylene or polyester by weight	(-)
Mass per unit area	minimum	oz/yd <sup>2</sup>	16	ASTM D 5261
<u>Mechanical Requirements</u>				
Grab strength	minimum	lb	350	ASTM D 4632 <sup>(1)</sup>
Tear strength	minimum	lb	120	ASTM D 4533 <sup>(2)</sup>
Puncture strength	minimum	lb	180	ASTM D 4833 <sup>(3)</sup>
Burst strength	minimum	psi	700	ASTM D 3786
<u>Durability Requirements</u>				
Ultraviolet Resistance	minimum	%	70	ASTM D 4355

## Notes:

- (1) Minimum of values measured in machine and cross machine directions with 1 inch clamp on Constant Rate of Extension (CRE) machine.
- (2) Minimum value measured in machine and cross machine direction.
- (3) Tension testing machine with a 1.75-inch diameter ring clamp, the steel ball being replaced with 0.31-inch diameter solid steel cylinder with flat tip centered within the ring clamp.
- (4) All values represent minimum average roll values.
- (5) mm = millimeter  
% = percent  
oz/yd<sup>2</sup> = ounce per square yard  
sec = second  
lb = pound  
psi = pound per square inch

TABLE 02714-5

REQUIRED PROPERTY VALUES FOR GEOTEXTILE SEPARATOR

PROPERTIES	QUALIFIER	UNITS <sup>(5)</sup>	SPECIFIED <sup>(4)</sup> PROPERTY VALUES	TEST METHOD
<u>Identification Requirements</u>				
Type	(-)	(-)	Nonwoven needlepunched	(-)
Polymer composition	minimum	%	95 polypropylene or polyester by weight	(-)
Mass per unit area	minimum	oz/yd <sup>2</sup>	6	ASIM D 5261
<u>Mechanical Requirements</u>				
Grab strength	minimum	lb	180	ASTM D 4632 <sup>(1)</sup>
Tear strength	minimum	lb	75	ASTM D 4533 <sup>(2)</sup>
Puncture strength	minimum	lb	75	ASTM D 4833 <sup>(3)</sup>
Burst strength	minimum	psi	350	ASTM D 3786
<u>Durability Requirements</u>				
Ultraviolet Resistance	minimum	%	70	ASTM D 4355

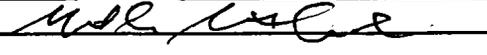
Notes:

- (1) Minimum of values measured in machine and cross machine directions with 1 inch clamp on Constant Rate of Extension (CRE) machine.
- (2) Minimum value measured in machine and cross machine direction.
- (3) Tension testing machine with a 1.75-inch diameter ring clamp, the steel ball being replaced with 0.31-inch diameter solid steel cylinder with flat tip centered within the ring clamp.
- (4) All values represent minimum average roll values.
- (5) mm = millimeter  
% = percent  
oz/yd<sup>2</sup> = ounce per square yard  
sec = second  
lb = pound  
psi = pound per square inch

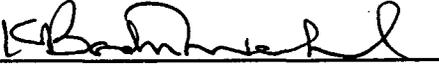
[END OF SECTION]

**SPECIFICATION COVER SHEET**

**SPECIFICATION SECTION:** 02721 **TITLE:** CULVERTS

**Specifications By:** Signature  Date 5 May 00  
 (Cognizant Engineer)  
Printed Name Michael J. Monteleone, P.E.  
and Title Senior Project Engineer

**Scope and Format**  
**Checked By:** Signature  Date 5 May 00  
 (Checker)  
Printed Name Michael J. Monteleone, P.E.  
and Title Senior Project Engineer

**Detailed Requirements**  
**Checked by:** Signature  Date 5 May 2000  
 (Checker)  
Printed Name Kwasi Badu-Tweneboah, Ph.D., P.E.  
and Title Senior Project Engineer

**Overall Review By:** Signature  Date 8 May 2000  
 (PDP)  
Printed Name J.F. Beech, Ph.D., P.E.  
and Title Principal

**Approved by:** Signature  Date 8 May 2000  
 (DTL)  
Printed Name J.F. Beech, Ph.D., P.E.  
and Title Principal

**Record of Revision (Number and initial all revisions)**

Rev. No.	Reason	Date	By	Checked	Approval
0	Certified for Construction	08 May 00		KBT	J.F.B.

**SECTION 02721****CULVERTS****PART 1 GENERAL****1.01 SCOPE**

- A. This Section includes materials and installation of culverts, HDPE slope drains, gravity inlet structures and related appurtenances.

**1.02 RELATED SECTIONS AND PLANS**

- A. Section 02100 - Surveying
- B. Section 02200 - Earthwork
- C. Section 02215 - Trenching and Backfilling
- D. Section 02271 - Riprap
- E. Section 02605 - High-Density Polyethylene (HDPE) Pipes and Fittings
- F. Part 8 - Environmental Health & Safety/Training Requirements
- G. Part 9 - Quality Assurance Requirements

**1.03 REFERENCES**

- A. Latest version of American Association of State Highway Transportation Officials (AASHTO) Standards:
  - 1. AASHTO M 36. Standard Specification for Corrugated Steel Pipe, Metallic-Coated, for Sewers and Drains.
  - 2. AASHTO M 170. Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe.
  - 3. AASHTO M 198. Standard Specification for Joints for Circular Concrete Sewer and Culvert Pipe Using Flexible Watertight Gaskets.
- B. Latest version of American Society of Testing Material (ASTM) Standard:
  - 1. ASTM C 478. Standard Specification for Precast Reinforced Concrete Manhole Section.

## **1.04 SUBMITTALS**

- A. Submit the following to the construction manager for review within 30 calendar days from Notice to Proceed:
  - 1. culverts, slopes/drains, and gravity inlet structures Manufacturer's product data and recommended methods of storage, handling, and proposed installation;
  - 2. shop drawings for culverts and gravity inlet structures showing the layout and details of joints, special connections, and fittings; and
  - 3. Manufacturer's written certification that culverts, gravity inlet structures, and joint material meet the material requirements of this Section.
- B. Provide list of equipment, description of installation methods, and other required information for installation of culverts, slope drains, and gravity inlet structures in the Contractor's Earthwork Work Plan specified in Section 02200.

## **1.05 HEALTH AND SAFETY REQUIREMENTS**

- A. Environmental health & safety/training requirements shall be in accordance with Part 8 of the Contract Documents.

## **1.06 CONTRACTOR'S QUALITY ASSURANCE**

- A. Contractor's quality assurance requirements shall be in accordance with Part 9 of the Contract Documents.

## **PART 2 PRODUCTS**

### **2.01 GENERAL**

- A. Furnish reinforced concrete pipe (RCP), circular culverts, corrugated metal pipe (CMP) culverts meeting requirements of AASHTO Standards as specified in this Section.

### **2.02 RCP CIRCULAR CULVERTS**

- A. Furnish RCP circular culverts meeting the requirements of AASHTO M 170 for Class IV Reinforced Concrete Pipe with Wall B.

### **2.03 CMP CULVERTS**

- A. Furnish CMP culverts meeting the requirements of AASHTO M 36 with minimum 0.064-inch thick sheets and corrugations of 2-2/3 inches by 1/2 inch.

**2.04 HDPE SLOPE DRAINS**

- A. Furnish HDPE slope drains as shown on the Construction Drawings. HDPE slope drain shall be SDR-26 HDPE pipe meeting the requirements of Section 02605.

**2.05 JOINTS**

- A. Furnish RCP circular joints with Type A culvert gaskets meeting the requirements of AASHTO M 198.
- B. Furnish CMP culvert joints with coupling bands and rubber O-ring meeting the requirements of AASHTO M 36. Use coupling bands fabricated from the same type of base metal coating as the CMP culverts.

**2.06 CULVERT OUTLET AND INLET PROTECTION**

- A. Furnish riprap meeting the requirements of Section 02271.

**2.07 GRAVITY INLET STRUCTURES**

- A. Gravity inlet structures and accessories shall be precast concrete meeting the requirements, of ASTM C 478.

**2.08 EQUIPMENT**

- A. Furnish equipment to perform work specified in this Section.

**PART 3 EXECUTION****3.01 INSTALLATION**

- A. Install culverts as shown on the Construction Drawings.
- B. Examine culverts and joint materials before installation. Install culverts in accordance with Manufacturer's installation recommendations and as approved by the Construction Manager.
- C. Prior to culvert installation, complete trenching and place pipe embedment fill in accordance with Section 02215 unless otherwise shown on the Construction Drawings.
- D. Install RCP circular culverts and CMP culverts to the lines and grades shown on the Construction Drawings.

- E. Install joints for RCP and CMP culverts in accordance with the Manufacturer's recommendations and AASHTO M198 and AASHTO M36 respectively.
- F. Extend RCP culvert as shown on Construction Drawings. Install RCP joint in accordance with Manufacturer's recommendation and AASHTO M 198.
- G. Install HDPE slope drain as shown on the Construction Drawings and as specified in Section 02605.
- H. Install gravity inlet structures as shown on the Construction Drawings.
- I. After installation of the culverts and gravity inlet structures, perform trench backfilling as specified in Section 02215.
- J. Culvert inlet and outlet protection shall be placed as shown on the Construction Drawings.

### **3.02 CONSTRUCTION QUALITY REQUIREMENTS**

- A. CQC Consultant will monitor culverts, HDPE slope drain, and gravity inlet structures installation to establish compliance with this Section and in accordance with the Construction Quality Assurance (CQA) Plan.

### **3.03 SURVEY CONTROL**

- A. Survey the final locations and invert elevations of the culverts, HDPE slope drain, and gravity inlet structures in accordance with Section 02100.

### **3.04 TOLERANCE**

- A. Install culverts, HDPE slope drain, and gravity inlet structures within  $\pm 0.1$  feet of the invert elevations indicated on the Construction Drawings and to provide positive drainage at all times.

[END OF SECTION]

**SPECIFICATION COVER SHEET**

**SPECIFICATION SECTION:** 02770 **TITLE:** GEOMEMBRANE LINER AND CAP

**Specifications By:** (Cognizant Engineer)  
 Signature *[Signature]* Date 5 May 00  
 Printed Name Michael J. Monteleone, P.E.  
 and Title Senior Project Engineer

**Scope and Format**  
**Checked By:** (Checker)  
 Signature *[Signature]* Date 5 May 00  
 Printed Name Michael J. Monteleone, P.E.  
 and Title Senior Project Engineer

**Detailed Requirements**  
**Checked by:** (Checker)  
 Signature *[Signature]* Date 5 May 2000  
 Printed Name Kwasi Badu-Tweneboah, Ph.D., P.E.  
 and Title Senior Project Engineer

**Overall Review By:** (PDP)  
 Signature *[Signature]* Date 8 May 2000  
 Printed Name J.F. Beech, Ph.D., P.E.  
 and Title Principal

**Approved by:** (DTL)  
 Signature *[Signature]* Date 8 May 2000  
 Printed Name J.F. Beech, Ph.D., P.E.  
 and Title Principal

**Record of Revision (Number and initial all revisions)**

Rev. No.	Reason	Date	By	Checked	Approval
0	Certified for Construction	08 May 00		KBT	JFB

**SECTION 02770****GEOMEMBRANE LINER AND CAP****PART 1 GENERAL****1.01 SCOPE**

- A. This Section includes materials and installation for geomembrane liner and cap (geomembrane) for the cell liner system and cell final cover system, respectively, including electrical leak detection testing of the primary geomembrane liner in the liner system and the geomembrane cap in the final cover system.
- B. Quantity of geomembrane liner and cap materials to be furnished by Fluor Fernald, Inc. will be as specified in Part 6 of the Contract Documents.

**1.02 RELATED SECTIONS AND PLANS**

- A. Section 02100 - Surveying
- B. Section 02215 - Trenching and Backfilling
- C. Section 02714 - Geotextiles
- D. Section 02772 - Geosynthetic Clay Liner and Cap
- E. Section 13005 - Liner Penetration Boxes
- F. Construction Quality Assurance (CQA) Plan
- G. Part 3 - General Provisions
- H. Part 6 - Statement of Work
- I. Part 8 - Environmental Health & Safety/Training Requirements
- J. Part 9 - Quality Assurance Requirements

**1.03 REFERENCES**

- A. Latest version of the American Society for Testing and Materials (ASTM) Standards:

1. ASTM D 638. Standard Test Method for Tensile Properties of Plastics.
  2. ASTM D 746. Standard Test Method for Brittleness Temperature of Plastics and Elastomers by Impact.
  3. ASTM D 1004. Standard Test Method of Initial Tear Resistance of Plastic Film and Sheeting.
  4. ASTM D 1204. Standard Plastics Test Method for Linear Dimensional Changes of Non Rigid Thermoplastic Sheeting or Film at Elevated Temperature.
  5. ASTM D 1238. Standard Test Method for Flow Rates of Thermoplastics by Extrusion Plastometer.
  6. ASTM D 1505. Standard Test Methods for Density of Plastics by Density-Gradient Technique.
  7. ASTM D 1603. Standard Test Method for Carbon Black in Olefin Plastics.
  8. ASTM D 4437. Practice for Determining the Integrity of Field Seams Used in Joining Flexible Polymeric Sheet Geomembranes.
  9. ASTM D 4833. Standard Test Method for Index Puncture-Resistance of Geotextiles, Geomembranes, and Related Products.
  10. ASTM D 5397. Standard Test Method for Evaluation of Stress Crack-Resistance of Polyolefin Geomembranes Using Notched Constant Tensile Load Test.
  11. ASTM D 5596. Recommended Practice for Microscopical Examination of the Dispersion of Carbon Black in Polyolefin Geosynthetics.
  12. ASTM D 5994. Standard Test Method for Measuring Core Thickness of Textured Geomembrane.
- B. Latest version of the Geosynthetic Institute (GSI) Test Procedures:
1. GSI GM 12 Standard Test Method for Asperity Measurement of Textured Geomembranes Using a Depth Gauge.
- C. Latest version of National Sanitation Foundation (NSF) 54, Flexible Membrane Liners, Annex A.

#### 1.04 SUBMITTALS

- A. Submit to the Construction Manager a letter of acceptance for the quantity of geomembrane materials furnished by Fluor Fernald, Inc. Quantity of geomembrane materials stored on site shall be inspected, inventoried, and accepted within 30 calendar days of Notice to Proceed.

- B. Submit to the Construction Manager for review the following information from the Installer at least 14 calendar days prior to mobilization of the Installer to the site.
1. Layout drawings showing the installation layout, identifying geomembrane panel configurations, dimensions, details, locations of seams, as well as any variance or additional details which deviate from the Construction Drawings. The layout drawings shall be adequate for use as a construction plan and shall include dimensions, details, etc. The layout drawings, as modified and/or approved by the Construction Manager, shall become part of the Contract.
  2. Installation schedule.
  3. Copy of Installer's letter of approval or license by the Manufacturer.
  4. Installation Work Plan, including:
    - a. list of equipment proposed for this project;
    - b. description of geomembrane installation methods;
    - c. coordination of geomembrane installation with installation of geotextile and geosynthetic clay liner and cap;
    - d. storage methods in accordance with Manufacturer's recommendations;
    - e. average daily placement anticipated for this project; and
    - f. quality assurance methods and procedures.
  5. A list of 10 completed facilities for which the Installer has installed a minimum of 10,000,000 square feet of polyethylene geomembrane. The following information shall be provided for each facility:
    - a. the name and purpose of the facility, its location, and dates of installation; the
    - b. names of the owner, project manager, and geomembrane manufacturer;
    - c. name of the supervisor of the installation crew;
    - d. thickness and surface area of installed geomembrane;
    - e. type of seaming and type of seaming apparatus used; and
    - f. duration of installation.
  6. Resumes of the Installer Superintendent and quality assurance inspector proposed for this project, including dates and duration of employment.
  7. Resumes of personnel who will perform seaming operations on this project, including dates and duration of employment.
  8. Evidence that the installation crew has the following experience.
    - a. The Superintendent shall have supervised the installation of a minimum of 5,000,000 square feet of polyethylene geomembrane.
    - b. At least one seamer shall have experience seaming a minimum of 1,000,000 square feet of polyethylene geomembrane using the same type of seaming apparatus to be used at this site. Seamers with such experience will be designated "master seamers" and shall provide direct supervision over less experienced seamers.
    - c. All other seaming personnel shall have seamed at least 100,000 square feet of polyethylene geomembrane using the same type of seaming apparatus to be

used at this site. Personnel who have seamed less than 100,000 square feet of seams shall be allowed to seam only under the direct supervision of the master seamer or Superintendent.

- C. Submit to the Construction Manager for review at least 14 calendar days prior to geomembrane placement, a Certificate of Calibration less than 12 months old for the field tensiometer, vacuum gauges, and pressure gauges. Tensiometer and gauges shall be calibrated within one year of date of test. Calibration shall be traceable to national or industry recognized standards where possible.
- D. Submit to the Construction Manager for review subgrade acceptance certificates, signed by the Installer, for each area to be covered by the geomembrane prior to that area being covered by geomembrane.
- E. Within 14 calendar days of completion of the geomembrane installation, submit to the Construction Manager the warranty for geomembrane installation as specified in Part 3 of the Contract Documents.
- F. Submit to the Construction Manager for review, an Electrical Leak Detection Testing Work Plan within 30 calendar days from Notice to Proceed. The Electrical Leak Detection Testing Work Plan shall include, but not be limited to, the following:
  - 1. qualification and experience of the specialty subcontractor proposed to implement the Electrical Leak Detection Testing Work Plan including the following:
    - a. the name of the specialty subcontractor company with minimum of 3 years of experience in the field of electrical leak detection testing;
    - b. a list of facilities for which the electrical leak detection testing specialty subcontractor has successfully performed electrical leak detection testing; the following shall be provided for each facility:
      - i. the names and purposes of the facility, its location, and dates of electrical leak detection testing;
      - ii. names of the leak detection supervisor and technicians;
      - iii. thickness and surface area of geomembrane tested; and
      - iv. duration of testing;
    - c. resumes of electrical leak detection testing supervisor proposed for this Contract; supervisor shall have a minimum of 200,000 square feet of electrical leak detection testing experience; and
    - d. resumes of electrical leak detection testing technicians;
  - 2. Leak detection testing:
    - a. description of the test methods and procedures to implement the Work Plan;
    - b. proposed voltage and grounding requirements;
    - c. methods for water management to implement the tests;

- d. description of safe work practices as required in Part 8 of the Contract Documents;
  - e. description of the quality assurance procedures; and
  - f. schedule showing various activities related to the electrical leak detection testing from mobilization to submission of the Electric Leak Detection Testing Report.
- G. Submit to Construction Manager a Leak Detection Testing Report within 7 calendar days after completion of electrical leak detection testing.

#### **1.05 HEALTH AND SAFETY REQUIREMENTS**

- A. Environmental health & safety/training requirements shall be in accordance with Part 8 of the Contract Documents.

#### **1.06 CONTRACTOR'S QUALITY ASSURANCE**

- A. Contractor's quality assurance requirements shall be in accordance with Part 9 of the Contract Documents.

### **PART 2 PRODUCTS**

#### **2.01 GEOMEMBRANE PRODUCTS**

- A. Geomembrane products furnished by Fluor Fernald, Inc. will meet or exceed the requirements specified in this Section.

#### **2.02 RESIN**

- A. Geomembrane furnished by Fluor Fernald, Inc. will be manufactured from new, first-quality polyethylene resin. No reclaimed polymer will be added to the resin. The use of polymer recycled during the manufacturing process is permitted if performed with appropriate cleanliness and if the recycled polymer during the manufacturing process does not exceed 2 percent by weight of the total polymer.
- B. High-density polyethylene (HDPE) resin will have the following properties:
1. Density: 0.934 g/cm<sup>3</sup> minimum (ASTM D 1505); and
  2. Melt Flow Index: 1.0 g/10 min., maximum (ASTM D 1238 Condition E).
- C. Extrudate welding material furnished by Fluor Fernald, Inc. will be of the same resin or compatible compound as the geomembrane furnished by Fluor Fernald, Inc., and will be

delivered in original sealed containers. Each container will have a label bearing the brand name, Manufacturer's lot number and directions as to proper storage.

### 2.03 GEOMEMBRANE PROPERTIES

- A. HDPE textured geomembrane furnished by Fluor Fernald, Inc. will have properties that meet or exceed the required property values specified in Table 02770-1.
- B. Width and approximate length of each HDPE geomembrane roll will be as specified in Part 6 of the Contract Documents.
- C. In addition, geomembrane will:
  - 1. contain a maximum of 1 percent by weight of additives, fillers, or extenders, not including carbon black; and
  - 2. not have striations, pinholes, bubbles, blisters, nodules, undispersed raw materials, or any sign of contamination by foreign matter on the surface or in the interior.

### 2.04 LABELING

- A. Each geomembrane roll furnished by Fluor Fernald, Inc. will be labeled with the following information:
  - 1. thickness of material;
  - 2. length and width of the roll;
  - 3. name of Manufacturer;
  - 4. product identification;
  - 5. lot number; and
  - 6. roll number.
- B. Geomembrane rolls not labeled in accordance with this Section or on which labels are illegible will be rejected and replaced. Contractor shall notify the Construction Manager of any missing or illegible labels and shall protect labels until rolls are incorporated into the cell.

### 2.05 ACCEPTANCE, HANDLING, AND STORAGE

- A. Upon delivery to the project site, Contractor shall inspect and inventory the geomembrane materials and the manner in which they are stored. Contractors shall also inspect and inventory geomembrane stockpile at the OSDF. Contractor shall provide to the Construction Manager, a letter of acceptance within 30 calendar days if material is acceptable for installation. Contractor shall also notify the Construction

Manager in writing within 30 calendar days of any geomembrane material not acceptable for installation.

- B. Protection and preservation of geomembrane material shall include, but not be limited to:
1. handling and storage of the geomembrane at the site;
  2. protection of the geomembrane from excessive heat or cold, dirt, puncture, cutting, or other damaging or deleterious conditions; and
  3. storage of geomembrane rolls on pallets or other elevated structures off the ground surface and not more than 3 rolls high.
- C. Contractor shall unload, handle, and store geomembrane material furnished by Fluor Fernald, Inc. Handling shall be performed such that damage to geomembrane materials does not occur.

## 2.06 EQUIPMENT

- A. Furnish equipment for acceptance, handling, storage, and installation of geomembrane specified in this Section.

## PART 3 EXECUTION

### 3.01 GEOMEMBRANE PLACEMENT

- A. General:
1. Do not place geomembrane until the layout drawings are approved by the Construction Manager.
  2. Do not place a geomembrane panel in an area until the Construction Manager has been provided with a certificate that the surface on which the geomembrane will be placed is acceptable.
  3. Do not place geomembrane until CQC Consultant completes conformance testing and confirmation of compliance of the geomembrane, and performance testing and confirmation of compliance of underlying layer, including acceptance of Contractor's survey results for underlying layer.
  4. Place each geomembrane panel in accordance with the approved layout drawings.
- B. Field Panel Identification:
1. Give each field panel an identification code (number or letter-number). This identification code shall be agreed upon by the CQC Consultant and the Installer.
  2. A geomembrane field panel is a roll or a portion of roll cut in the field.

C. Field Panel Placement:

1. Place one geomembrane panel at a time and seam each panel immediately after its placement.
2. Use temporary rub-sheets as required to prevent displacement or damage to underlying geosynthetics.
3. Do not place geomembrane panels when the ambient temperature is below 40° Fahrenheit (°F) or above 104°F, unless authorized in writing by the Construction Manager. For placement below 40°F or above 104°F, use the installation methods recommended by the geomembrane Manufacturer and approved in writing by the Construction Manager.
4. Do not place geomembrane in areas of ponded water, or in the presence of high wind which make geomembrane placement unsafe.
5. Verify that:
  - a. No vehicular traffic is driven directly on the geomembrane.
  - b. Equipment used does not damage the geomembrane by handling, trafficking, or leakage of hydrocarbons (i.e., fuels).
  - c. Personnel working on the geomembrane do not smoke, bring glass onto the geomembrane, or engage in other activities that could damage the geomembrane.
  - d. The method used to unroll the panels does not scratch or crimp the geomembrane and does not damage underlying geosynthetics or the supporting layer.
  - e. The method used to place the panels minimizes wrinkles (especially differential wrinkles between adjacent panels). The method used to place the panels results in intimate contact with the underlying geosynthetic clay liner or cap. Adjust or repair any area of geomembrane wrinkles where the wrinkle height, measured perpendicular to the slope during the hottest portion of the day, is more than 4 inches;
  - f. The method used to place the panels does not cause the panels to lift up or trampoline during the coolest portion of the day.
  - g. The geomembrane is anchored or weighted with sandbags, or the equivalent, to prevent damage or uplift from wind. Install sufficient anchoring or weighting to prevent uplift and maintain such system until overlying material is placed.
6. Replace any field panel or portion thereof that becomes damaged (torn, twisted, or crimped). Remove from the work area damaged panels or portions of damaged panels.

- D. Do not install geomembrane between one hour before sunset and one hour after sunrise unless approved in writing by the Construction Manager.

**3.02 FIELD SEAMING**

- A. Personnel shall be experienced as specified in this Section. Do not perform seaming unless a "master seamer" and the CQC Consultant are on-site.
- B. Orient seams parallel to the line of maximum slope (i.e., oriented down, not across, the slope). Minimize the number of seams in corners and at odd-shaped geometric locations. No horizontal seam shall be less than 10 feet from the toe of the slope, except where approved in writing by the Construction Manager. Do not locate seams at an area of potential stress concentration.
- C. Seams shall be shingled in the downward direction of the slope.
- D. Weather Conditions for Seaming:
1. Do not seam geomembrane at ambient temperatures below 40°F or above 104°F. For seaming below 40°F or above 104°F, use the seaming method recommended by the geomembrane Manufacturer and approved in writing by the Construction Manager.
  2. Measure ambient temperatures at 6 inches above the geomembrane surface.
  3. In all cases, the geomembrane seam areas shall be dry and protected from wind.
- E. Overlapping and Temporary Bonding:
1. Sufficiently overlap geomembrane panels for welding and to allow peel tests to be performed on the seam as specified in this Section. Any seams that cannot be destructively tested because of insufficient overlap are failing seams.
  2. Control the temperature of the air at the nozzle of heat bonding apparatus such that the geomembrane is not damaged.
- F. Seam Preparation:
1. Prior to seaming, clean the seam area and ensure that area to be bonded is free of moisture, dust, dirt, debris of any kind, and foreign material.
  2. If seam overlap grinding is required, complete the process according to the Manufacturer's instructions within 20 minutes of the seaming operation. Do not grind to a depth that exceeds ten percent of the geomembrane thickness. Grinding marks shall not appear beyond 0.25 inch of the extrudate after it is placed.
  3. Align seams with the fewest possible number of wrinkles and "fishmouths".
- G. General Seaming Requirements:
1. Extend seams to the outside edge of panels to be placed in the anchor trench.
  2. If required, place a firm substrate such as a flat board or similar hard surface directly under the seam overlap to achieve proper support.

3. Cut fishmouths or wrinkles at the seam overlaps along the ridge of the wrinkle to achieve a flat overlap. Seam the cut fishmouths or wrinkles and patch any portion where the overlap is less than 6 inches with an oval or round patch of geomembrane that extends a minimum of 6 inches beyond the cut in all directions.
4. Place the electric generator used for power supply to the welding machines outside the area to be lined, or mount it on soft tires, or place on a rub sheet such that no damage occurs to the geomembrane. Properly ground the electric generator. Place a smooth insulating plate or fabric beneath the hot welding apparatus after use.

H. Seaming Process:

1. Approved processes for field seaming are extrusion welding and fusion welding. Use only geomembrane Manufacturer-approved equipment.
2. Extrusion Equipment and Procedures:
  - a. Maintain at least one spare operable seaming apparatus on site.
  - b. Equip extrusion welding apparatus with gauges giving the temperature in the apparatus and at the nozzle.
  - c. Prior to beginning a seam, purge the extruder until all heat-degraded extrudate has been removed from the barrel. Whenever the extruder is stopped, purge the barrel of all heat-degraded extrudate.
3. Fusion Equipment and Procedures:
  - a. Maintain at least one spare operable seaming apparatus on site.
    - i. Fusion-welding apparatus shall be automated self-propelled devices equipped with gauges giving the applicable temperatures and travel speed.
  - b. Fusion-welding apparatus shall produce a double-track seam.
  - c. Abrade the edges of cross seams to a smooth incline (top and bottom) prior to extrusion welding.

I. Trial Seams:

1. Make trial seams on excess pieces of geomembrane to verify that seaming conditions are adequate. Conduct trial seams on the same material to be installed and under similar field conditions as production seams. Conduct trial seaming at the beginning of each seaming period, and at least once each four hours, for each seaming apparatus used that day prior to seaming. Also, each seamer shall make at least one trial seam each day, for each day that seaming is performed by that seamer. Conduct trial seaming under the same conditions as the actual seaming. Prepare trial seams that are approximately 15 feet long by 1 foot wide (after seaming), with the seam centered lengthwise for fusion equipment and at least 3 feet long by 1 foot wide for extrusion equipment. Prepare seam overlap as specified in this Section.

2. Cut four specimens, each 1.0 inch wide, from the trial seam sample. Test two specimens in shear and two in peel, using a field tensiometer. The test specimens shall not fail in the seam. If a specimen fails, repeat the entire operation. If the additional specimen fails, do not accept the seaming apparatus or seamer until the deficiencies are corrected and two consecutive successful trial seams are achieved. A seamer may start production seaming prior to testing of the trial seams. In the event the trial seam fails, all production seams by the seamer are failed seams.

J. Nondestructive Seam Continuity Testing:

1. Nondestructively test for continuity field seams over their full length. Perform continuity testing as the seaming work progresses, not at the completion of field seaming. Complete any required repairs in accordance with this Section. Apply the following procedures:
  - a. Use vacuum testing for extrusion welds.
  - b. Use air pressure testing for double-track fusion seams.
2. Vacuum Testing:
  - a. Use the following equipment:
    - i. A vacuum box assembly consisting of a stiff housing, a transparent viewing window, a soft neoprene gasket attached to the bottom, port hole or valve assembly, and a vacuum gauge.
    - ii. A system for applying 5 pounds per square inch (psi) gauge suction to the box.
    - iii. A bucket of soapy solution and applicator.
  - b. Follow these procedures:
    - i. Energize the vacuum pump and reduce the tank pressure to  $5 \pm 1$  psi gauge.
    - ii. Wet an area of the geomembrane seam larger than the vacuum box with the soapy solution.
    - iii. Place the box over the wetted area.
    - iv. Close the bleed valve and open the vacuum valve.
    - v. Ensure that a leak tight seal is created.
    - vi. Examine the geomembrane through the viewing window for the presence of soap bubbles for not less than 20 seconds.
    - vii. If no bubbles appear after 20 seconds, close the vacuum valve and open the bleed valve, move the box over the next adjoining area with a minimum 3 inch overlap, and repeat the process.
    - viii. Mark all areas where soap bubbles appear with a marker that will not damage the geomembrane and repair in accordance with this Section.
3. Air Pressure Testing:
  - a. Use the following equipment:

- i. An air pump (manual or motor driven) or air reservoir, equipped with a pressure gauge, capable of generating and sustaining a pressure between 25 and 30 pounds per square inch.
    - ii. A rubber hose with fittings and connections.
    - iii. A hollow needle, or other approved pressure feed device.
  - b. Follow these procedures:
    - i. Seal both ends of the seam to be tested.
    - ii. Insert needle, or other approved pressure feed device, into the tunnel created by the fusion weld.
    - iii. Insert a protective cushion between the air pump and the geomembrane.
    - iv. Energize the air pump to a pressure between 25 and 30 pounds per square inches, close valve, and sustain the pressure for not less than 5 minutes.
    - v. If loss of pressure exceeds 3 pounds per square inches, or does not stabilize, locate faulty area and repair in accordance with this Section.
    - vi. Cut opposite end of air channel from pressure gauge and observe release of pressure to ensure air channel is not blocked.
    - vii. Remove needle, or other approved pressure feed device, and seal both ends in accordance with the "Defects and Repairs" Article of this Part.
4. Electrical Leak Detection Testing:
  - a. Implement electrical leak detection testing program on the primary geomembrane liner and the geomembrane cap in accordance with the Electrical Leak Detection Testing Work Plan specified in this Section. Electrical leak detection testing shall include:
    - i. Provision of materials as required by the Electrical Leak Detection Testing Work Plan to implement the electrical leak detection testing program;
    - ii. Identification of areas requiring repair by field marking, in person, and in writing and on a field sketch, to the CQC Consultant, Construction Manager, and the geomembrane Installer's supervisor; and
    - iii. Submission of electrical leak detection testing report for the geomembrane liner or cap that is tested; at a minimum the report shall contain information on the methods and procedures used and location of all detected leaks.
  - b. Perform electric leak detection testing after performance testing of geomembrane is completed by the CQC Consultant.

**K. Destructive Testing:**

1. Perform destructive seam tests to evaluate seam strength and integrity. Perform destructive testing as the seaming work progresses, not at the completion of field seaming.

2. Sampling and Testing:
    - a. Collect destructive test samples at a minimum average frequency of one test location per 500 feet of seam length and at additional locations of suspected nonperformance. The CQC Consultant will select test locations, including locations with evidence of excess geomembrane crystallinity, contamination, offset seams, or any other evidence of inadequate seaming.
    - b. Cut samples at the locations designated by the CQC Consultant at the time the locations are designated. Number each sample and identify the sample number and location on the panel layout drawing. Immediately repair holes in the geomembrane resulting from the destructive seam sampling in accordance with the repair procedures described in this Section. Test the continuity of the new seams in the repaired areas according to this Section.
    - c. Cut two strips 1 inch wide and 12 inches long with the seam centered parallel to the width from either side of the sample location. Test the two 1-inch wide strips in the field tensiometer in the peel mode. The CQC Consultant may request an additional test in the shear mode. If these samples pass the field test, prepare a laboratory sample at least 1 foot wide by 3.5 feet long with the seam centered lengthwise. Cut the laboratory sample into three parts and distribute as follows:
      - i. one portion 1 foot long to the Installer;
      - ii one portion 1.5 feet long to the CQC Consultant for testing; and
      - iii one portion 1 foot long to the Construction Manager for archival storage.
  3. In the event of failing field or laboratory test results, the Contractor may reconstruct the entire seam between two passing destructive tests; otherwise, the CQC Consultant will identify the extent of the nonconforming area following the methods specified in the Construction Quality Assurance (CQA) Plan. Obtain additional samples for testing as requested by the CQC Consultant.
- L. Defects and Repairs:
1. Inspect the geomembrane before and after seaming for evidence of defects, holes, blisters, undispersed raw materials, and any sign of contamination by foreign matter. The surface of the geomembrane shall be clean at the time of inspection. Sweep or wash the geomembrane surface if surface contamination inhibits inspection. Review results of electrical leak detection testing and repair in accordance with this Section.
  2. Test each suspect location, both in seam and non-seam areas, using the methods described in this Section. Repair each location that fails nondestructive testing.
  3. Cut and re-seam wrinkles not conforming to this Section. Test the re-seams in the same manner as seams described in this Section.

4. Repair Methods:

- a. Repair any portion of the geomembrane exhibiting a flaw, or failing a destructive or nondestructive test. The appropriate repair method shall be agreed upon between the Contractor and the Construction Manager. Use the most appropriate of the available methods:
  - i. patching - used to repair large holes, tears, undispersed raw materials, and contamination by foreign matter;
  - ii. abrading and re-seaming - used to repair small sections of extruded seams;
  - iii. spot seaming - used to repair minor, localized flaws;
  - iv. capping - used to repair long lengths of failed seams;
  - v. topping - used to repair areas of inadequate seams, which have an exposed edge less than 4 inches in length; and
  - vi. removing bad seam and replacing with a strip of new material seamed into place (used with long lengths of fusion seams).
- b. When making repairs, satisfy the following:
  - i. abrade surfaces of the geomembrane that are to be repaired no more than 20 minutes prior to the repair;
  - ii. clean and dry all geomembrane surfaces immediately prior to repair;
  - iii. only use approved seaming equipment;
  - iv. extend patches or caps at least 6 inches beyond the edge of the defect, and round corners of patches to a radius of at least 3 inches; and
  - v. cut the geomembrane below large caps to avoid potential for water or gas collection between the two sheets.

5. Repair Verification:

- a. Test each repair using the methods described in this Section. Repairs that pass the nondestructive test are adequate unless the CQC Consultant elects to also perform destructive tests. Re-repair and retest failed tests.
- b. Final verification of geomembrane primary liner and cap repair shall be performed using electrical leak detection test.

**3.03 CREST ANCHOR SYSTEM**

- A. Temporarily anchor each geomembrane panel in the anchor trench at the crest of the slope as soon as the panel is deployed or positioned.
- B. Do not entrap soil, sand bags, or other materials below or between the geosynthetic layers.
- C. Do not backfill the anchor trench until all geosynthetic layers are installed in the anchor trench. Do not place geomembrane in anchor trench if standing water is present. Backfill in accordance with the Construction Drawings and Section 02215.

- D. Do not damage any geosynthetic layer when backfilling the anchor trench.

### 3.04 MATERIALS IN CONTACT WITH THE GEOMEMBRANE

- A. Take necessary precautions to prevent damage to the geomembrane and its texturing during the installation of other components of the liner system or final cover system.
- B. Do not drive equipment directly on the geomembrane. Only use equipment above the geomembrane that meets the following ground pressure requirements:

<u>Maximum Allowable Equipment Ground Pressure (pounds per square inches)</u>	<u>Minimum Thickness of Overlying Fill or Aggregate Materials (inches)</u>
less than 5	12
less than 10	18
less than 20	24
greater than 20	36

- C. Penetrations:
1. Install the geomembrane at liner penetrations, and connect the geomembrane to penetrating pipes and the liner penetration boxes in accordance with the Construction Drawings and Section 13005. Take extreme care while seaming around appurtenances as neither nondestructive nor destructive testing may be feasible in certain areas.

### 3.05 CONSTRUCTION QUALITY REQUIREMENTS

- A. The CQC Consultant will test geomembrane destructive seam samples to confirm compliance with seam performance requirements specified in this Section. Performance testing and frequency shall be in accordance with the CQA Plan.
- B. The CQC Consultant will monitor geomembrane installation in accordance with this Section and the CQA Plan.

### 3.06 SURVEY CONTROL

- A. Survey the installed geomembrane liner or cap in accordance with Section 02100.

TABLE 02770-1

REQUIRED HDPE TEXTURED GEOMEMBRANE PROPERTIES

Properties	Qualifiers	Units <sup>(1)</sup>	Specified Property Values		Test Method
			Liner	Cap	
<b>Physical Properties</b>					
Thickness	average	mils	>80	>60	ASTM D 5994
	minimum	mils	76	58	ASTM D 5994
Density	minimum		0.94	0.94	ASTM D 1505
Carbon Black Content	range	g/cm <sup>3</sup>			
		%	2-3	2-3	ASTM D 1603
Carbon Black Dispersion	N/A	none	Cat. 1 or 2	Cat. 1 or 2	ASTM D 5596
<u>Asperity Height</u>	minimum	mils	7	7	GRI-GM12
<b>Mechanical Properties</b>					
Tensile Properties (each direction)					
1. Force Per Unit Width at Yield	minimum	lb/in.	168	126	ASTM D 638 Type IV
2. Tensile Strength (force per unit width at break)	minimum	lb/in.	120	90	ASTM D 638 Type IV
3. Elongation at Yield	minimum	%	12	12	ASTM D 638 Type IV
4. Elongation at Break	minimum	%	100	100	ASTM D 638 Type IV
Tear Resistance	minimum	lb	56	42	ASTM D 1004 Die C Puncture
Puncture Resistance	minimum	lb	120	90	ASTM D 4833
<b>Environmental Properties</b>					
Low Temperature Brittleness	maximum	°C	-60	-60	ASTM D 746 Procedure B
Dimensional Stability (each direction)	maximum change	%	± 2	± 2	ASTM D 1204 212°F, 15 min.
<b>Environmental Stress Crack Resistance</b>					
1. Notched Constant Tensile Load	minimum	hrs	500 <sup>(2)</sup>		ASTM D 5397

TABLE 02770-1 (continued)

## Notes:

1.    %    =    percent  
      g    =    grams  
      min =    minutes  
      lb/in. = pounds per inch  
      lb    =    pound  
      °C    =    degrees Celsius  
      hrs. =    hours
2.    Time-to-failure at a tensile stress of 30% of the tensile yield strength. Test is conducted on smooth geomembrane from the same lot (batch) as the textured geomembrane furnished.

TABLE 02770-2

REQUIRED HDPE TEXTURED GEOMEMBRANE SEAM PROPERTIES

Properties	Qualifiers	Units <sup>(3)</sup>	Specified Property Values		Test Method <sup>(4)</sup>
			Liner 80 mil	Cap 60 mil	
<u>Shear Strength<sup>(1)</sup></u>					
Fusion	minimum	lb/in.	151	113	ASTM D 4437
Extrusion	minimum	lb/in.	151	113	ASTM D 4437
<u>Peel Adhesion</u>					
FTB <sup>(2)</sup>					
Fusion	minimum	lb/in.	115	88	ASTM D 4437
Extrusion	minimum	lb/in.	84	63	ASTM D 4437

- Notes: 1. Also called "Bonded Seam Strength". Value is at material yield point.  
2. FTB = Film Tear Bond. (Maximum 10 percent seam separation).  
3. lb/in. = pounds per inch.  
4. Conditioning of test samples shall be minimum one hour at standard laboratory atmosphere.

[END OF SECTION]

SPECIFICATION COVER SHEET

SPECIFICATION SECTION: 02772 TITLE: GEOSYNTHETIC CLAY LINER AND CAP

Specifications By: Signature [Signature] Date 5 May 00
(Cognizant Engineer) Printed Name Michael J. Monteleone, P.E.
and Title Senior Project Engineer

Scope and Format Checked By: Signature [Signature] Date 5 May 00
(Checker) Printed Name Michael J. Monteleone, P.E.
and Title Senior Project Engineer

Detailed Requirements Checked by: Signature [Signature] Date 5 May 2000
(Checker) Printed Name Kwasi Badu-Tweneboah, Ph.D., P.E.
and Title Senior Project Engineer

Overall Review By: Signature [Signature] Date 8 May 2000
(PDP) Printed Name J.F. Beech, Ph.D., P.E.
and Title Principal

Approved by: Signature [Signature] Date 8 May 2000
(DTL) Printed Name J.F. Beech, Ph.D., P.E.
and Title Principal

Record of Revision (Number and initial all revisions)

Table with 6 columns: Rev. No., Reason, Date, By, Checked, Approval. Row 0: Certified for Construction, 08 May 00, [Signature], EBT, JFB.

**SECTION 02772****GEOSYNTHETIC CLAY LINER AND CAP****PART I GENERAL****1.01 SCOPE**

- A. This Section includes materials and installation for geosynthetic clay liner and cap for the cell liner system and cell final cover system, respectively.
- B. Quantity of geosynthetic clay liner and cap to be furnished by Fluor Fernald, Inc. will be as specified in Part 6 of the Contract Documents.

**1.02 RELATED SECTIONS AND PLANS**

- A. Section 02200 - Earthwork
- B. Section 02215 - Trenching and Backfilling
- C. Section 02225 - Compacted Clay Liner and Cap
- D. Section 02710 - Granular Drainage Material
- E. Section 02714 - Geotextiles
- F. Section 02770 - Geomembrane Liner and Cap
- G. Construction Quality Assurance (CQA) Plan
- H. Part 6 - Statement of Work
- I. Part 8 - Environmental Health & Safety/Training Requirements
- J. Part 9 - Quality Assurance Requirements

**1.03 REFERENCES**

- A. Latest version of American Society for Testing and Materials (ASTM) Standards:
  - 1. ASTM D 4595. Standard Test Method for Tensile Properties of Geotextiles by Wide-Width Strip Method.

2. ASTM D 4632. Standard Test Method for Grab Breaking Load and Elongation of Geotextiles (Grab method).
3. ASTM D 4643. Standard Test Method for Determination of Water (Moisture) Content of Soil by Microwave Oven Method.
4. ASTM D 5084. Standard Test Method for Measurement of Saturated Porous Materials Using a Flexible Wall Permeameter.
5. ASTM D 5887. Standard Test Method for Measurement of Index Flux through Saturated Geosynthetic Clay Liner Specimens Using a Flexible Wall Permeameter.
6. ASTM D 5890. Standard Test Method for Swell Index of Clay Mineral Component of Geosynthetic Clay Liners.
7. ASTM D 5891. Standard Test Method for Fluid Loss of Clay Component of Geosynthetic Clay Liners.
8. ASTM D 5993. Standard Test Method for Measuring Mass per Unit Area of Geosynthetic Clay Liner.

#### 1.04 SUBMITTALS

- A. Submit to the Construction Manager a letter of acceptance for the quantity of geosynthetic clay liner and cap furnished by Fluor Fernald, Inc. Quantity of geosynthetic clay liner and cap stored on site shall be inspected, inventoried, and accepted within 30 calendar days of Notice to Proceed.
- B. Submit to the Construction Manager for review the following information from the Installer for the geosynthetic clay liner and cap within 14 calendar days prior to mobilization of the Installer to the site:
  1. Installation schedule.
  2. Installation Work Plan, including:
    - a. list of placement equipment proposed for this project;
    - b. description of installation methods;
    - c. coordination of geosynthetic clay liner and cap installation with installation of compacted clay liner and cap, geotextiles, and geomembrane liner and cap;
    - d. storage methods in accordance with Manufacturer's recommendations;
    - e. average daily placement anticipated for this project; and
    - f. quality assurance methods and procedures.
  3. A list of 10 completed facilities for which the Installer has installed a geosynthetic clay liner and cap. The following information shall be provided for each facility:
    - a. the name and purpose of the facility, its location, and dates of installation;

- b. the names of the owner, project manager, and geosynthetic clay liner and cap Manufacturer;
  - c. name of the supervisor of the installation crew;
  - d. thickness and surface area of installed geosynthetic clay liner and cap; and
  - e. duration of installation.
4. Resumes of the Installer Superintendent and quality assurance inspector proposed for this project, including dates and duration of employment.
- C. Submit to the Construction Manager for review subgrade acceptance certificates, signed by the Installer, for each area to be covered by the geosynthetic clay liner and cap prior to that area being covered.

### **1.05 HEALTH AND SAFETY REQUIREMENTS**

- A. Environmental health & safety/training requirements shall be in accordance with Part 8 of the Contract Documents.

### **1.06 CONTRACTOR'S QUALITY ASSURANCE**

- A. Contractor's quality assurance requirements shall be in accordance with Part 9 of the Contract Documents.

## **PART 2 PRODUCTS**

### **2.01 GEOSYNTHETIC CLAY LINER AND CAP**

- A. Fluor Fernald, Inc. will furnish geosynthetic clay liner and cap materials that meet the following requirements:
- 1. Geosynthetic clay liner and cap will consist of internally-reinforced bentonite core with nonwoven geotextile and woven geotextile backings, as indicated on the Construction Drawings.
  - 2. Geosynthetic clay liner and cap will have properties that comply with the required values shown in Table 02772-1.
  - 3. Fluor Fernald, Inc. will provide granular or powdered bentonite in accordance with the manufacturer's specifications for geosynthetic clay liner and cap.
- B. Width and approximate length of each geosynthetic clay liner and cap roll will be as specified in Part 6 of the Contract Documents.

## 2.02 PACKAGING

- A. Geosynthetic clay liner and cap rolls will be wrapped in impermeable and opaque protective covers.
- B. Each geosynthetic clay liner and cap roll will be marked or tagged with the following information:
  - 1. Manufacturer's name;
  - 2. product identification;
  - 3. lot number;
  - 4. roll number;
  - 5. roll weight; and
  - 6. roll dimensions.
- C. Geosynthetic clay liner and cap rolls not labeled in accordance with this Section or on which labels are illegible will be rejected and replaced. Contractor shall notify the Construction Manager of any missing or illegible labels.

## 2.03 ACCEPTANCE, HANDLING AND STORAGE

- A. Upon delivery to the site, Contractor shall inspect and inventory the geosynthetic clay liner and cap materials and the manner in which they are stored. Contractor shall also inspect and inventory geosynthetic by inventorying stockpile. Contractor shall provide a written letter of acceptance within 30 days to the Construction Manager if material is acceptable for installation. Contractor shall also notify the Construction Manager in writing within 30 days of any geosynthetic clay liner and cap material not acceptable for installation.
- B. Protection and preservation of geosynthetic clay liner and cap materials shall include, but not be limited to:
  - 1. handling, storage, and care for the geosynthetic clay liner and cap in a manner that does not cause hydration or damage;
  - 2. protection of the geosynthetic clay liner and cap from moisture, excessive heat or cold, dirt, puncture, or other damaging or deleterious conditions; and
  - 3. storage of the geosynthetic clay liner and cap rolls on pallets or other elevated structures.
- C. Contractor shall unload, handle, and store geosynthetic clay liner or cap material furnished by Fluor Fernald, Inc. Handling shall be performed such that damage to geosynthetic clay liner and cap materials does not occur.

**2.04 EQUIPMENT**

- A. Furnish equipment for acceptance, handling, storage, and installation of geosynthetic clay liner and cap.

**PART 3 EXECUTION****3.01 SURFACE PREPARATION**

- A. Geosynthetic clay liner and cap Installer shall submit to the Construction Manager certification in writing that the surface on which the geosynthetic clay liner and cap will be installed is acceptable as described in this Section.
- B. The surface in which the geosynthetic clay liner and cap is to be placed shall contain no loose stones and no ruts greater than 1/2-inch depth.
- C. Protect the compacted clay liner and cap in accordance with Section 02225. Protect the leak detection system (LDS) drainage layer in accordance with Section 02710.
- D. Do not place the geosynthetic clay liner and cap onto an area that has been softened by precipitation or that has unacceptable desiccation as specified in Section 02225. Repair such areas in accordance with Section 02225.

**3.02 CREST ANCHOR SYSTEM**

- A. Excavate the anchor trench in accordance with Section 02215 prior to geosynthetic clay liner placement. Excavate to the lines and grades shown on the Construction Drawings.
- B. The anchor trench beneath the geosynthetic clay liner shall be firm, clean, and dry.
- C. Temporarily anchor the geosynthetic clay liner in the anchor trench until all geosynthetic layers are installed in the anchor trench. Do not place geosynthetic clay liner in anchor trench if standing water is present.
- D. Backfill the anchor trench in accordance with Section 02215
- E. Do not damage exposed geosynthetic layer when backfilling the anchor trench.

### 3.03 PLACEMENT

- A. Do not place geosynthetic clay liner and cap until the CQC Consultant completes conformance testing and confirmation of compliance, and performance testing and confirmation of compliance of underlying layers, including acceptance of Contractor's survey results for underlying layers.
- B. Cut the geosynthetic clay liner and cap using a sharp utility blade. Do not damage underlying material during cutting and fully repair any such damage.
- C. Do not entrap stones or other foreign objects under the geosynthetic clay liner and cap. Do not drag equipment across the exposed geosynthetic clay liner and cap.
- D. Replace any geosynthetic clay liner and cap that is damaged.
- E. Install geosynthetic clay liner and cap with the nonwoven geotextile backing in contact with the underlying layer. Install adjacent geosynthetic clay liner and cap panels such that they are shingled down slope.
- F. Do not install the geosynthetic clay liner and cap on a wet subgrade or in standing water. Prevent hydration of the bentonite core prior to completion of construction of the liner system or final cover system.
- G. Do not install the geosynthetic clay liner and cap during precipitation or other conditions that may cause hydration of the geosynthetic clay liner and cap.
- H. Install the overlying geomembrane as soon as possible following geosynthetic clay liner and cap installation. Cover all geosynthetic clay liner and cap that is placed during a work day with overlying geomembrane. Cover and protect the edges of geosynthetic clay liner and cap from hydration due to surface water runoff.
- I. Remove and replace geosynthetic clay liner and cap that become hydrated. Hydration is defined by a moisture content of 40 percent or greater when measured in accordance with ASTM D 4643.
- J. Place the LDS, leachate collection system (LCS), or cover drainage layer material for the liner system or final cover system on top of the geomembrane and other geosynthetics overlying the geosynthetic clay liner and cap as soon as possible after installation of the geosynthetic clay liner and cap.

**3.04 OVERLAPS**

- A. On slopes steeper than 5 horizontal to 1 vertical, install geosynthetic clay liners continuously down the slope; that is, allow no horizontal seams on the slope.
- B. Allow no horizontal seams on the side slopes within 5 feet of the toe of a slope.
- C. Overlap geosynthetic clay liner and cap in strict accordance with the Manufacturer's recommended methods. As a minimum, overlap adjacent panels at least 6 inches along the sides and 12 inches along the ends of installed panels.
- D. Overlaps shall be shingled in the downward direction of the slope.
- E. Use of granular or powdered bentonite to enhance bonding at the seams shall be in accordance with the geosynthetic clay liner and cap manufacturer's recommendations.

**3.05 MATERIALS IN CONTACT WITH THE GEOSYNTHETIC CLAY LINER AND CAP**

- A. Perform installation of other components in a manner that prevents damage to the geosynthetic clay liner and cap.
- B. Do not drive equipment directly on the geosynthetic clay liner and cap unless approved in writing by the Construction Manager. Damage due to equipment operating on the geosynthetic clay liner and cap shall be repaired or replaced at no additional cost to Fluor Fernald, Inc.
- C. Install the geosynthetic clay liner and cap in appurtenant areas as shown on Construction Drawings. Do not damage the geosynthetic clay liner and cap while working around the appurtenances.

**3.06 REPAIR**

- A. Repair holes or tears in the geosynthetic clay liner and cap by placing a geosynthetic clay liner and cap patch over the hole. On slopes greater than 5 percent, the patch shall overlap the edges of the hole or tear by a minimum of 2 feet in all directions. On slopes 5 percent or flatter, the patch shall overlap the edges of the hole or tear by a minimum of 1 foot in all directions. Secure the patch with a water-based adhesive approved by the geosynthetic clay liner and cap Manufacturer. Repairs shall be in strict accordance with Manufacturer's recommendations.

- B. Remove soil or other material that may have penetrated the torn geosynthetic clay liner and cap.
- C. Do not nail or staple the patch.

**3.07 CONSTRUCTION QUALITY REQUIREMENTS**

- A. The CQC Consultant will monitor geosynthetic clay liner and cap installation in accordance with this Section and Construction Quality Assurance (CQA) Plan.
- C. Provide evidence of strict adherence to the above listed requirements.

TABLE 02772-1

## REQUIRED GEOSYNTHETIC CLAY LINER AND CAP PROPERTY VALUES

PROPERTIES	QUALIFIERS	UNITS <sup>(4)</sup>	SPECIFIED <sup>(1)</sup> PROPERTY VALUES	TEST METHOD
<u>Geosynthetic Clay Liner and Cap Properties</u>				
Bentonite Content <sup>(2)</sup>	minimum	lb/ft <sup>2</sup>	1.0	ASTM D 5993
Bentonite Moisture Content	maximum	%	25	ASTM D 4643
Bentonite Fluid Loss	maximum	ml	8	ASTM D 5891
Bentonite Free Swell	minimum	ml/2g	24	ASTM D 5890
Hydraulic Conductivity <sup>(3)</sup>	minimum	cm/s	5 x 10 <sup>-9</sup>	ASTM D 5887
<u>Geotextile Properties</u>				
Polymer Composition	minimum	%	95 polyester or polypropylene	

- Notes:
- All values represent minimum average roll values (i.e., any roll in a lot should meet or exceed the values in this table).
  - Measured at a moisture content not exceeding 25 percent.
  - Test at an effective confining stress of 5 psi.
  - |                    |   |                           |
|--------------------|---|---------------------------|
| lb/ft <sup>2</sup> | = | pounds per square foot    |
| cm/s               | = | centimeter per second     |
| g                  | = | grams                     |
| %                  | = | percent                   |
| lb                 | = | pound                     |
| lb/in.             | = | pounds per inch           |
| ml/2g              | = | milliliters per two grams |

**SPECIFICATION COVER SHEET**

**SPECIFICATION SECTION:** 02831 **TITLE:** CHAIN-LINK FENCES

**Specifications By:** (Cognizant Engineer)  
 Signature [Signature] Date 5 May 00  
 Printed Name Michael J. Monteleone, P.E.  
 and Title Senior Project Engineer

**Scope and Format**  
**Checked By:** (Checker)  
 Signature [Signature] Date 5 May 00  
 Printed Name Michael J. Monteleone, P.E.  
 and Title Senior Project Engineer

**Detailed Requirements**  
**Checked by:** (Checker)  
 Signature [Signature] Date 5 May 2000  
 Printed Name Kwasi Badu-Tweneboah, Ph.D., P.E.  
 and Title Senior Project Engineer

**Overall Review By:** (PDP)  
 Signature [Signature] Date 8 May 2000  
 Printed Name J.F. Beech, Ph.D., P.E.  
 and Title Principal

**Approved by:** (DTL)  
 Signature [Signature] Date 8 May 2000  
 Printed Name J.F. Beech, Ph.D., P.E.  
 and Title Principal

**Record of Revision (Number and initial all revisions)**

Rev. No.	Reason	Date	By	Checked	Approval
0	Certified for Construction	08 May 00		EBT	JFB.

**SECTION 02831****CHAIN-LINK FENCES****PART 1 GENERAL****1.01 SCOPE**

- A. This Section includes materials and installation for chain-link fences.
- B. Contractor may reuse mesh, fabric, barbed wire, and supporting arms that are removed as part of relocating the existing chain-link fences, as shown on the Construction Drawings and approved by the Construction Manager. Furnish additional materials as specified in this Section.

**1.02 RELATED SECTIONS AND PLANS**

- A. Section 02100 - Surveying
- B. Section 02200 - Earthwork
- C. Construction Quality Assurance (CQA) Plan
- D. Part 8 - Environmental Health & Safety/Training Requirements
- E. Part 9 - Quality Assurance Requirements

**1.03 REFERENCES**

- A. Latest version of the American Society for Testing and Materials (ASTM) Standards:
  - 1. ASTM A 121. Standard Specification for Zinc-Coated (Galvanized) Steel Barbed Wire.
  - 2. ASTM A 123. Standard Specification for Zinc (Hot Dip Galvanized) Coatings on Iron and Steel Products.
  - 3. ASTM A 153/153M. Standard Specification for Zinc-Coated (Hot Dip) on Iron and Steel Hardware.
  - 4. ASTM A 392. Standard Specification for Zinc-Coated Steel Chain-Link Fence Fabric.

- B. Latest version of National Fire Protection Association (NFPA) Standards:
  - 1. NFPA 70. National Electrical Code.
- C. Latest version of Underwriters Laboratories, Inc. (UL) Standard:
  - 1. UL 467. UL Standard for Safety Grounding and Banding Equipment.
- D. Latest version of Ohio Department of Transportation Construction and Material Specifications (Ohio DOT Specifications).

#### **1.04 SUBMITTALS**

- A. Submit the following to the Construction Manager for review within 30 calendar days from Notice to Proceed:
  - 1. Manufacturer's product data and shop drawings showing details for fence, hardware, footings, groundings, and installation.
- B. Provide a list of equipment, description of construction methods, and other required information for installation of chain-link fences in the Contractor's Earthwork Work Plan specified in Section 02200.

#### **1.05 HEALTH AND SAFETY REQUIREMENTS**

- A. Environmental health & safety/training requirements shall be in accordance with Part 8 of the Contract Documents.

#### **1.06 CONTRACTOR'S QUALITY ASSURANCE**

- A. Contractor's quality assurance requirements shall be in accordance with Part 9 of the Contract Documents.

### **PART 2 PRODUCTS**

#### **2.01 GENERAL**

- A. Furnish 6-foot high chain-link fencing as shown on the Construction Drawings. At corners and end posts, use vertical stretcher bars and horizontal and diagonal bracing rods which extend to the first adjacent line post. Use a fence with a top rail, 1 foot of three-strand barbed wire above the top rail, and a bottom tension wire as shown on the Construction Drawings.

**2.02 FABRIC**

- A. Furnish 6-foot high chain-link fabric woven from 9-gauge steel wire galvanized in accordance with ASTM A 392 Class II in a 2-inch mesh. Use a wire with a minimum breaking strength of 1,200 pounds.

**2.03 POSTS AND FITTINGS**

- A. Furnish hot-dip galvanized posts and rails conforming to ASTM A 123 with American Steel Association (ASA) Schedule 40 steel pipe sizes as follows:
1. line posts shall be 2.375 inches outside diameter (O.D.);
  2. end, corner, and pull posts shall be 2.875 inches O.D.;
  3. top brace rails shall be 1.66 inches O.D.; and
  4. post brace shall be 1.66 inches O.D.
- B. Furnish Class C (4000 pounds per square inch) concrete as specified in Ohio DOT Specifications.
- C. Furnish brace bands, tension bands, tie-rods, and turn-buckles manufactured from malleable iron or pressed steel and coated in accordance with ASTM A 153.
- D. Furnish galvanized stretcher bars in one piece lengths equal to the full height of the chain-link fabric with a minimum cross section of 0.1875 inches by 0.75 inches and coated in accordance with ASTM A 153. Provide stretcher bars for end posts and corner posts.
- E. Furnish 9-gauge steel tie wire and 7-gauge steel tension wire galvanized in accordance with ASTM A 123.

**2.04 SUPPORTING ARMS AND BARBED WIRE**

- A. Furnish supporting arms:
1. coated in accordance with ASTM A 153/153M;
  2. oriented at 45 degrees to vertical (orient outward); and
  3. manufactured from malleable iron or pressed steel.
- B. Furnish supporting arms with caps which securely fit to the tops of posts to exclude moisture and have openings to receive top rail.

- C. Furnish three rows of barbed wire manufactured from two-strand, 12.5-gauge wire with 14-gauge, 4-point barbs spaced at 5 inches on center and galvanized in accordance with ASTM A 121, Class 3.

## 2.05 GROUNDINGS

- A. Grounding rod electrical shall be 3/4-inch diameter, 10-foot long copper-clad steel.
- B. Materials for grounding connectors shall be as shown on the Construction Drawings.
- C. Grounding conductors shall be stranded copper wire meeting NFPA 70 requirements.
- D. Grounding and bonding material shall conform to UL 467.

## 2.06 EQUIPMENT

- A. Furnish equipment to install chain link fences and fence grounding.

## PART 3 EXECUTION

### 3.01 INSTALLATION

- A. Perform final grading prior to installation of chain link fencing. Install fencing as shown on the Construction Drawings and follow the general lines and grades of the finished ground.
- B. Installation:
  - 1. Set posts plumb in concrete as shown on the Construction Drawings. Concrete shall be as specified in this Section. Posts shall be in a straight alignment, with temporary bracing until concrete has set. Trowel finish and slope exposed tops of concrete footings to promote drainage away from the posts.
  - 2. Install pull posts every 300 feet if no corner posts are encountered in that distance.
  - 3. Install corner posts at changes in direction of 30 degrees or more and pull posts at changes in direction of 15 degrees or more. Install pull posts at abrupt changes in grade.
  - 4. Install supporting arms on each post.
- C. Set post bracing as specified below after concrete in post bases has set.

1. Install pull posts at end posts and at each side of corner posts; install so posts are plumb when diagonal rod is under tension.
- D. Install top brace rails as specified below.
1. Continuously run through barbed wire supporting arms.
  2. Install expansion couplings at each joint.
- E. Install chain-link fabric as specified below:
1. Stretch taut with equal tension on each side of line posts.
  2. Install fabric on security side of fence and anchor to framework so that fabric remains in tension after pulling force is released.
  3. Use U-shaped tie wire, conforming to diameter of pipe to which fabric is being attached, clasping pipe and fabric firmly with ends twisted at least two full turns. Bend ends of wire to minimize hazard to persons or clothing.
  4. Fasten fabric to line posts with tie wire spaced at a maximum of 12 inches on center.
  5. Fasten fabric to top rail with tie wire spaced at a maximum of 24 inches on center.
  6. Join roll of fabric together by weaving a single strand into the end of the roll to form a continuous piece.
  7. Install nuts for tension bands and hardware bolts on side of fence opposite fabric side. (Peen ends of bolts or score threads to prevent removal of nuts.)
  8. Attach tension wire and pull tension wire taut along the bottom of the fabric with ring-type fasteners spaced at a maximum of 24 inches on center.
  9. Attach tension wire to line posts with brace bands and pull taut.
- F. Install stretcher bars as described below.
1. Thread through or clamp to fabric at a maximum of 4 inches on center.
  2. Secure to posts with metal bands spaced 15 inches on center maximum.
  3. Install at each gate, pull and end posts, and both sides of corner post.
- G. Install barbed wire as described below.
1. Attach 3 rows to each barbed wire supporting arm. Pull wire taut and fasten securely to each arm.
- H. Install fence grounding as indicated on the Construction Drawings.
- I. Repair any damaged coating in the shop or field by recoating with compatible and similar coating. Apply coating per manufacturer's recommendation.

**3.02 CONSTRUCTION QUALITY REQUIREMENTS**

- A. CQC Consultant will monitor chain-link fence installation to establish compliance with this Section and in accordance with the Construction Quality Assurance (CQA) Plan.

**3.03 SURVEY CONTROL**

- A. Survey the location and alignment of chain-link fence in accordance with Section 02100.

**3.04 TOLERANCE**

- A. Erect the chain-link fences with a maximum variation from plumb of 0.25 inches.
- B. Erect the chain-link fences with a maximum offset of 1 inch from true position.

[END OF SECTION]

**SPECIFICATION COVER SHEET**

**SPECIFICATION SECTION:** 02920 **TITLE:** TOPSOIL

**Specifications By:** (Cognizant Engineer) Signature *[Signature]* Date 5 May 00

Printed Name Michael J. Monteleone, P.E.  
and Title Senior Project Engineer

**Scope and Format**

**Checked By:** (Checker) Signature *[Signature]* Date 5 May 00

Printed Name Michael J. Monteleone, P.E.  
and Title Senior Project Engineer

**Detailed Requirements**

**Checked by:** (Checker) Signature *[Signature]* Date 5 May 2000

Printed Name Kwasi Badu-Tweneboah, Ph.D., P.E.  
and Title Senior Project Engineer

**Overall Review By:** (PDP) Signature *[Signature]* Date 8 May 2000

Printed Name J.F. Beech, Ph.D., P.E.  
and Title Principal

**Approved by:** (DTL) Signature *[Signature]* Date 8 May 2000

Printed Name J.F. Beech, Ph.D., P.E.  
and Title Principal

**Record of Revision (Number and initial all revisions)**

Rev. No.	Reason	Date	By	Checked	Approval
0	Certified for Construction	08 May 00		KBT	JFB

**SECTION 02920****TOPSOIL****PART 1 GENERAL****1.01 SCOPE**

- A. This Section includes topsoil materials and placement.

**1.02 RELATED SECTIONS AND PLANS**

- A. Section 02100 - Surveying
- B. Section 02200 - Earthwork
- C. Section 02250 - Vegetative Soil Layer
- D. Section 02270 - Surface-Water Management and Erosion Control
- E. Section 02930 - Vegetation
- F. Construction Quality Assurance (CQA) Plan
- G. Part 6 - Statement of Work
- H. Part 8 - Environmental Health & Safety/Training Requirements
- I. Part 9 - Quality Assurance Requirements

**1.03 REFERENCES**

- A. Latest version of American Society for Testing and Materials (ASTM) Standards:
  - 1. ASTM D 422. Standard Test Method for Particle-Size Analysis of Soils.
  - 2. ASTM D 2974. Standard Test Methods for Moisture, Ash, and Organic Matter of Peat and Other Organic Soil.
- B. *"Soil Taxonomy, A Basic System of Soil Classification for Making and Interpreting Soil Surveys"*, Agriculture Handbook Number 436, Second Edition, [U.S. Department of Agriculture Soil Conservation Service, 1999].

#### **1.04 SUBMITTALS**

- A. Include a list of the equipment, description of construction methods, and other required information for topsoil construction in the Contractor's Earthwork Work Plan specified in Section 02200.

#### **1.05 HEALTH AND SAFETY REQUIREMENTS**

- A. Environmental health & safety/training requirements shall be in accordance with Part 8 of the Contract Documents.

#### **1.06 CONTRACTOR'S QUALITY ASSURANCE**

- A. Contractor's quality assurance requirements shall be in accordance with Part 9 of the Contract Documents.

### **PART 2 PRODUCTS**

#### **2.01 MATERIALS**

- A. Obtain topsoil from on-site borrow areas, on-site excavations and topsoil stockpiles shown on the Construction Drawings. Topsoil shall meet the following material requirements:
  - 1. Material shall be a loam, clay loam, silty clay loam, silt loam or sandy clay loam, as classified by U.S. Department of Agriculture Soil Conservation Service [1999], and be loose and friable. For topsoil to be considered loamy, that fraction passing the U.S. Standard No. 10 sieve shall contain not more than 40 percent clay-sized fraction, as determined in accordance with ASTM D 422.
  - 2. Topsoil shall be free of metal, debris, foreign objects, rock fragments larger than 4 inches, and stumps and other deleterious materials.
  - 3. Topsoil shall contain not less than 2 percent organic matter as determined by loss on ignition of samples oven dried to constant weight per ASTM D 2974, Method A for moisture content determination and Method C for ash content determination.
- B. Identify source for topsoil material a minimum of 30 calendar days prior to use to allow the CQC Consultant time to perform conformance testing and to confirm compliance of topsoil material specified in this Section.

#### **2.02 EQUIPMENT**

- A. Furnish equipment required to haul, place, and spread topsoil.

**PART 3 EXECUTION****3.01 PLACEMENT**

- A. Install surface-water management and erosion control measures to protect the topsoil layer in accordance with Section 02270.
- B. Do not commence placement of topsoil until CQC Consultant completes conformance testing and confirmation of compliance of topsoil material and acceptance of the Contractor's survey results of the vegetative soil layer as specified in Section 02100 and in accordance with Section 02250.
- C. Prior to spreading the topsoil, scarify or otherwise loosen the top surface of the previous soil layer to a minimum depth of 1 inch. Scarify using a disc harrow, rake, or other method approved by the Construction Manager.
- D. Place topsoil to the thickness, grades and limits shown on the Construction Drawings. Round breaks between slopes on the final cover system.
- E. Place, spread, and track with a Caterpillar D3 bulldozer, or equivalent equipment approved by the Construction Manager, so that the equipment grouser marks are perpendicular to the direction of surface water flow.
- F. Do not spread topsoil in water or while frozen or in saturated conditions. If soil or weather conditions are unsuitable, as determined by the Construction Manager, cease placing topsoil until approval to resume topsoil operations is obtained from the Construction Manager.
- G. After topsoil has been placed and spread, remove stiff clods, lumps, roots, litter, and other foreign material. Remove visible stiff clods larger than 3-inches in diameter and rock fragments larger than 4-inches. Reduce clods larger than 3-inches in size by raking, discing, or other processing.
- H. After the completion of the placement of topsoil, vegetate in accordance with Section 02930.
- I. Repair any erosion or washout of the topsoil layer and revegetate prior to final acceptance of vegetation by the Construction Manager as specified in Section 02930.
- J. Dust control shall be in accordance with Part 6 of the Contract Documents.

### **3.02 CONSTRUCTION QUALITY REQUIREMENTS**

- A. CQC Consultant will perform soil conformance testing on the topsoil material to establish compliance with this Section. Conformance testing to be performed and minimum testing frequencies shall be in accordance with the Construction Quality Assurance (CQA) Plan.
- B. CQC Consultant will monitor topsoil placement in accordance with this Section and the CQA Plan.

### **3.03 SURVEY CONTROL**

- A. Survey the limits, thickness, and surface of the topsoil layer in accordance with Section 02100.

### **3.04 TOLERANCE**

- A. Construct the topsoil layer to within  $\pm 0.1$  feet of the thickness shown on the Construction Drawings.
- B. Construct the topsoil layer to within 0.0 to +0.5 feet of the grades indicated on the Construction Drawings.

[END OF SECTION]

**SPECIFICATION COVER SHEET**

**SPECIFICATION SECTION:** 02930 **TITLE:** VEGETATION

**Specifications By:** Signature [Signature] 5 May 00  
(Cognizant Engineer) Date

Printed Name Michael J. Monteleone, P.E.  
and Title Senior Project Engineer

**Scope and Format**

**Checked By:** Signature [Signature] 5 May 00  
(Checker) Date

Printed Name Michael J. Monteleone, P.E.  
and Title Senior Project Engineer

**Detailed Requirements**

**Checked by:** Signature [Signature] 5 May 2000  
(Checker) Date

Printed Name Kwasi Badu-Tweneboah, Ph.D., P.E.  
and Title Senior Project Engineer

**Overall Review By:**  
(PDP)

Signature [Signature] 8 May 2000  
Date

Printed Name J.F. Beech, Ph.D., P.E.  
and Title Principal

**Approved by:**  
(DTL)

Signature [Signature] 8 May 2000  
Date

Printed Name J.F. Beech, Ph.D., P.E.  
and Title Principal

**Record of Revision (Number and initial all revisions)**

Rev. No.	Reason	Date	By	Checked	Approval
0	Certified for Construction	08 May 00		KBT	J.F.B.

**SECTION 02930****VEGETATION****PART 1 GENERAL****1.01 SCOPE**

- A. This Section includes soil stabilization, which includes application of crusting agent and establishing vegetation by seeding. The work in this Section includes, but is not limited to; soil preparation, interim vegetation, permanent vegetation, application of fertilizer, application of mulches, and application of crusting agent.

**1.02 RELATED SECTIONS AND PLANS**

- A. Section 02200 - Earthwork
- B. Section 02270 - Surface-Water Management and Erosion Control
- C. Part 6 - Statement of Work
- D. Part 8 - Environmental Health & Safety/Training Requirements
- E. Part 9 - Quality Assurance Requirements

**1.03 REFERENCES**

- A. Latest version of Ohio Department of Natural Resources (ODNR) Rainwater and Land Development Standards (ODNR Rainwater and Land Development Standards).
- B. *"Identification and Listing of Hazardous Waste"*, Title 40, Code of Federal Regulations (CFR), Part 261, Subpart E.C.
- C. *"Federal Hazardous Material Transportation Law"*, U.S. Department of Transportation [U.S. DOT, 1994].

**1.04 SUBMITTALS**

- A. Submit the following to the Construction Manager for review within 15 calendar days from Notice to Proceed:

1. proposed mixes and application rates for seed, mulch, fertilizers, and crusting agents;
  2. Manufacturer's product data and recommended methods of application for seed, mulches, fertilizer, and crusting agents;
  3. product data for fertilizer shall also include chemical analysis including uranium analysis to assure there is no resultant or derived uranium from fertilizer use, unless waived by Construction Manager;
  4. material safety data sheet (MSDS) for fertilizer, mulch binder and crusting agent; and
  5. inoculant information for the permanent seed mixes.
- B. Submit the following to the Construction Manager for review within 30 calendar days before seeding:
1. certificate stating seed mixture, guaranteed percentages of purity, weed content, germination of seed, name of seller, test date for the seed, and the net weight and date of shipment;
  2. Manufacturer's certificate stating the available nutrients contained in the proposed fertilizer;
  3. Manufacturer's certificate stating that the fiber matrix (wood fibers) meets the requirements of this Section;
  4. Manufacturer's certificate stating the mulch binder meets the requirements of this Section;
  5. Manufacturer's certificate stating the crusting agent meets the requirements of this Section; and
  6. documentation of the straw to be used for mulch; this documentation shall verify that the straw is weed free in accordance with the requirements of this Section.
- C. Submit to the Construction Manager for review within 10 calendar days before seeding a plan showing seeding area and a written statement of application rate of seed mix and/or associated materials (i.e., fertilizer, mulch, and mulch binder). Choice of seeding type shall follow the site seeding requirements and as approved by the Construction Manager.
- D. Provide a list of equipment, description of construction methods, and other required information for vegetation and application of crusting agent in the Contractor's Earthwork Work Plan specified in Section 02200.

## **1.05 HEALTH AND SAFETY REQUIREMENTS**

- A. Environmental health & safety/training requirements shall be in accordance with Part 8 of the Contract Documents.

**1.06 CONTRACTOR'S QUALITY ASSURANCE**

- A. Contractor's quality assurance requirements shall be in accordance with Part 9 of the Contract Documents.

**PART 2 PRODUCTS****2.01 MATERIALS**

- A. Furnish seed labeled in accordance with U.S. Department of Agriculture (USDA) Rules and Regulations under the Federal Seed Act and applicable State seed laws. Furnish seed in sealed bags or containers bearing the date of expiration. Do not use seed after its date of expiration. Each variety of seed shall have a purity of not less than 90 percent by weight, a percentage of germination not less than 80 percent by weight, and a weed to seed content of not more than 0.75 percent by weight and contain no noxious weeds. Furnish seed mixtures having seed proportioned by weight in accordance with Tables 02930-1A, 02930-1B, and 02930-2. Areas requiring permanent seeding during the summer months (July 1 – September 20) shall be seeded with 30 lbs/acre of ReGreen or stabilize with a crusting agent as specified in this Section. Stabilization performed during the summer shall be followed by fall application of the appropriate permanent seed mix.
- B. Permanent seed mixes shall be treated with fungal (Mycorrhizae) inoculant and bacterial (Rhyzobium) inoculants. The specified legumes must be inoculated with the appropriate Rhizobial strains.
- C. Furnish mulch meeting the following requirements:
1. Mulch shall be straw or wood cellulose fiber, free of clay, stone, foreign substances, and free of weeds.
  2. Straw should not contain sticks larger than ¼-inch diameter or other materials that may prevent matting down during application. Use straw that is free from mold and other objectionable material for placing with mulch blower equipment or other equipment as approved by the Construction Manager. Straw shall be generally 6 inches or more in length.
  3. Straw shall be:
    - a. weed free straw from the Minnesota Crop Improvement Association certified weed free straw vendors;
    - b. straw that has been inspected and determined to be weed free by Central Ohio Seed Testing;
    - c. native prairie grass mulch; or

- d. equivalent substitute as approved by the Construction Manager.
4. Mulch applied by hydrospraying shall be a bonded fiber matrix containing wood fibers held together with a hydrocolloid-based binder, which upon drying becomes insoluble and non-dispersible. The fibers shall be composed of 100 percent wood or wood by-products and shall be 100 percent biodegradable. Use a bonded fiber matrix containing a green dye that will provide for easy visual inspection for uniformity of slurry spread. The bonded fiber matrix, including dye, shall contain no growth or germination inhibiting properties. The wood cellulose fiber shall be manufactured in such a manner that, after addition and agitation in slurry tanks with water, the fibers in the material become uniformly suspended to form a homogeneous material. When sprayed on the ground, the material shall allow absorption and percolation of moisture. The wood cellulose fiber shall meet the following requirements:

<u>Item</u>	<u>Specification Limit</u>
Particle Length	0.4 inch (maximum)
Particle Thickness	0.047 inch (maximum)
pH	4.0 to 8.5
Ash Content	1.6 % (maximum)
Water Holding Capacity (based on fiber dry weight)	500 % (minimum)
Moisture Content	12 % ± 3 % (by weight)

- D. Mulch binder agent shall be as approved by the Construction Manager and shall meet the following requirements:
1. The mulch binder shall be hydrocolloid base (guar gum) and shall not dissolve or disperse upon rewetting.
  2. The mulch binder shall not have hazardous characteristics of ignitability, corrosivity, reactivity, or toxicity as defined in 40 CFR Part 261, Subpart C, for a hazardous waste in either its pre-applied or cured states.
  3. The mulch binder shall have a flash point greater than 200°F. The mulch binder shall be neither a flammable nor combustible liquid per United States (US) Department of Transportation definition [U. S. DOT, 1994]. The mulch binder must not be susceptible to significant deterioration from exposure to the elements, including sunlight.
  4. The mulch binder shall be provided in concentrated solution and prepared so that it will not change in transportation or storage.

- E. The crusting agent shall be as approved by the Construction Manager and shall meet the following criteria:
1. pine sap emulsion comprised of a 100 percent organic emulsion produced from naturally occurring resins (pine sap); or a mixture of Conwed Fiber's Enviroblend hydraulic mulch and Finn Corporation's A-500 Hydro-Stik tacking agent (mulch binder); or an approved equal;
  2. not comprised of chloride, lignosulfonate, petroleum, or asphaltic-type emulsions;
  3. provide dust suppression and surface stability for exposed soils, both disturbed and undisturbed soils, and exposed coal fired ash (fly ash);
  4. compatible with application via a hydro seeder, and must not require intense cleaning of equipment after application;
  5. non-tracking (i.e., will not stick to boots or tires) once cured;
  6. not have hazardous characteristics of ignitability, corrosivity, reactivity, or toxicity as defined in 40 CFR Part 261, Subpart C, for a hazardous waste in either its pre-applied or cured states;
  7. have a flash point greater than 200 °F;
  8. be neither a flammable nor combustible liquid per DOT definition; and
  9. not be susceptible to significant deterioration from exposure to the elements, including sunlight.
- F. Erosion mat shall be in accordance with Section 02270.
- G. Fertilizer:
1. Furnish commercial grade fertilizer, uniform in composition that meets the requirements of all State and Federal regulations and standards of the Association of Agricultural Chemists.
  2. Fertilizer shall be slow release complete fertilizer.
  3. Two types of fertilizer mixes shall be used. Fertilizer for application within the former production area shall be 34-0-10; other fertilizers may be approved by the Construction Manager for the former production area, but they must not contain phosphorous. Fertilizer for other areas shall be 22-5-10. Fertilizers shall contain not less than 1 percent added sulfur and not more than 8 percent added iron, or an approved equal.
  4. Fertilizer must have MSDS submitted in accordance with this Section.
  5. Fertilizer shall be used for interim seeding only.
- H. Construction water shall be obtained from the on-site water source shown on the Construction Drawings.

## **2.02 EQUIPMENT**

- A. Provide equipment of size and type to perform work specified in this Section.

## **PART 3 EXECUTION**

### **3.01 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver containerized materials in uniform packages bearing the name of the manufacturer, the net weight and a statement of content. Deliver containerized materials to the site in original, properly labeled, unopened, clean containers each showing the manufacturer's guaranteed analysis conforming to applicable regulations and standards.
- B. Store materials in a dry area in a manner to prevent physical damage.

### **3.02 GENERAL**

- A. Stabilization of disturbed areas by vegetation or by use of a crusting agent shall be performed at completion of excavation and stockpiles or within 7 calendar days of knowing a disturbed area will be idle for more than 45 calendar days, whichever is sooner.
- B. Crusting agents may be used as temporary measures prior to placement of interim vegetation after approval for the area by the Construction Manager.
- C. Interim vegetation, as specified in this Section, is required for all areas except OSDF final cover system and soil stockpiles, which are scheduled to be disturbed in future. Fertilizer shall be used for interim vegetation as specified in this Section.
- D. Permanent vegetation, as specified in this Section, is required for OSDF final cover system. No fertilizer shall be used with permanent vegetation as specified in this Section.
- E. Disturbed areas which are scheduled to be significantly disturbed after initial stabilization and/or need effective erosion control immediately, are to be stabilized with the interim seed mix rate specified in this Section. Disturbed areas which are not scheduled to be significantly disturbed again are to be stabilized with the permanent seed mix rate specified in this Section. Soil piles, which require effective erosion control immediately, are to be stabilized with the interim seed mix rate or a crusting agent as specified in this Section.
- F. Stabilization of permanent slopes between 2H:1V and 3H:1V (horizontal to vertical) shall utilize an erosion mat as specified in Section 02270 after application of seed mixture.

- G. Area(s) to be seeded shall be generally free of debris, rock, root material, and other objects that may impede soil preparation and seeding activities. Perform soil preparation by tilling/cultivating, to a depth of approximately 2 inches, to eliminate uneven areas and low spots. Maintain lines, levels and contours.
- H. Repeat cultivation in areas where equipment used for hauling and spreading has compacted the area(s) to be seeded.

### 3.03 APPLICATION

- A. The seeding season, for interim vegetation specified in this Section, is year round. However, if seeding is contemplated during the winter months of December through March, then field conditions should be assessed for ability to provide soil to seed contact. If field conditions do not support the ability to provide soil to seed contact then the area shall be stabilized with a crusting agent followed by seeding during conditions conducive to adequate soil to seed contact.
- B. The seeding seasons for permanent seeding in wet and dry areas are Spring Season between April 1 and July 1 and Fall Season between September 20 and November 30.
- C. Apply fertilizer, seed, and mulch to disturbed areas and areas excavated and graded under this Contract requiring seeding unless otherwise directed by the Construction Manager. Apply mulch within 24 hours of seeding; do not seed areas in excess of that which can be mulched within 24 hours. Winter application of seed and related materials are subject to adjustment as directed by the Construction Manager.
- D. Apply seed using either the drilling, broadcasting, or hydroseeding method, as described below:
  - 1. Seed drilling method:
    - a. This method shall be used for applying the permanent seed mix in accessible areas unless otherwise approved by the Construction Manager. The method may also be used for interim vegetation.
    - b. Prepare area to be seeded by loosening the soil to a minimum depth of 3 inches.
    - c. Apply commercial grade, slow release complete fertilizer, for interim vegetation only, at a rate of 150 lbs/acre at the time of preparing the seedbed for seeding.
    - d. Install seed with a seed drill to obtain a final planting depth of ¼ to ½ inch using the seed rates indicated in Tables 02930-1A, 02930-1B, and 02930-2. All seed drilling should be done perpendicular to the direction of surface-water flow.

- e. Mulch and disc-anchor the area using weed free mulch at a rate of 2.0 tons per acre. Spread straw mulch, either by hand or by blowing method, at the rate of 2 air-dried tons per acre. During June through September, increase straw mulch application rate to 3 air-dried tons per acre. Application of straw mulch by the blowing method is exempt from the dust control requirements specified in Part 6 of the Contract Documents. When interseeding with the seed drill, mulch may not be required if 90 percent ground cover exists.
2. Broadcast Seeding Method:
- a. This method may be used for interim vegetation, and can be performed with the use of mechanical "cyclone" seeders, by hand seeding or by any other method which scatters seed over the soil surface.
  - b. This method may also be used for permanent seeding in areas that are not accessible with the seed drill (i.e., sloped areas) as approved by the Construction Manager.
  - c. If Broadcast Method is used to apply permanent seed mix in sloped areas (3H:1V slope or steeper), seeding application rates in Tables 02930-1A and 02930-1B should be doubled.
  - d. Prepare the area to be seeded by loosening the soil to a minimum depth of 3 inches. This is critical to allow seeds to filter into the soil to avoid washout from runoff.
  - e. Apply commercial grade, slow release complete fertilizer, for interim vegetation only, at a rate of 150 lbs/acre at the time of preparing the seedbed for seeding.
  - f. Install seed by broadcasting evenly over the entire site using the seed rates indicated in Table 02930-2.
  - g. Rake the area after seeding.
  - h. Mulch and disc-anchor using weed free mulch at a rate of 2.0 tons per acre. Spread straw mulch, either by hand or by blowing method, at the rate of 2 air-dried tons per acre. During June through September, increase straw mulch application rate to 3 air-dried tons per acre. Application of straw mulch by the blowing method is exempt from the dust control requirements specified in Part 6 of the Contract Documents.
3. Hydroseeding Method:
- a. This method may be used for interim vegetation only. Hydroseeding shall be a two-step process. The seed shall be applied first, followed by a separate application of the mulch. This is to ensure soil to seed contact.
  - b. The mixture tank shall be cleaned prior to use to ensure remnant seed is not introduced to the proposed seed mixture.
  - c. Prepare area to be seeded by loosening the soil to a minimum depth of 3 inches. This is critical to allow seeds to filter into the soil to avoid washout from runoff.

- d. Apply commercial grade, slow release complete fertilizer, for interim vegetation only, at a rate of 150 lbs/acre. The fertilizer is to be mixed and applied with the mulch.
- e. Install seed by hydroseeding evenly over the entire area using the seed rates indicated in Table 02930-2. Use a fan-type nozzle with approximately 500 gallons of water per acre to ensure even distribution.
- f. Rake the area where accessible following seeding.
- g. Apply sprayed mulch at a net dry weight of 2,000 pounds per acre minimum and 100 percent continuous coverage. Mix the mulch with water at a ratio of 50 pounds of mulch per 100 gallons of water.

E. Application of Crusting Agent:

1. Apply crusting agent in accordance with manufacturer's directions.
2. Unless otherwise specified by the manufacturer, dilute concentrated pine sap emulsion to ratio of 4 parts water to 1 part concentrate. Apply diluted pine sap emulsion at a rate of 2,500 gallons per acre.
3. Apply a mixture of Conwed Fiber's Enviroblend hydraulic mulch and Finn Corporation's A-500 Hydro-Stik mulch binder, using the hydroseeder, at the rate of 1,000 lbs/acre on flat surfaces; and 1,125 lbs/acre on slopes greater than 3H:1V. The mixture rate for each product shall be 20 lbs/acre on flat surfaces and 30 lbs/acre on greater than 3H:1V slopes for the hydraulic mulch; and 20 lbs/acre on flat surfaces and 30 lbs/acre on slopes greater than 3H:1V for the Hydro-Stik mulch binder.

### 3.05 MAINTENANCE

- A. Maintain the vegetated areas in satisfactory condition until acceptance of the vegetation by the Construction Manager. Maintenance of the vegetated areas includes repairing eroded areas, revegetating when necessary, watering, and mowing (if applicable). A satisfactory condition of vegetated area is defined as follows:
  1. an area shall have a predominant stand of the seeded vegetation;
  2. within 3 weeks, germination must occur over 90 percent of the area with no single bare area greater than 3 square feet; and
  3. within 3 months, 90 percent of the area must be covered with mature vegetation.
- B. The above timeframes for germination and coverage requirements are to be delayed during the dormant season between November 1 and March 15 application of the seed. The performance criteria shall be measured at the beginning of the growing season (April 1) for seed applied during the previous dormant season.

- C. Areas that fail to meet these requirements shall be repaired or reseeded as necessary to produce an acceptable stand of vegetation, as specified in this Section.
- D. The acceptance inspection will be performed by the Construction Manager who will determine whether repair of vegetated areas or revegetation is required.
- E. Maintain areas with a crusting agent to ensure proper erosion control. The crusting agent shall be reapplied to eroded and bare areas as necessary.

### **3.06 WARRANTY**

- A. Vegetated areas shall be subject to a warranty period of not less than 12 months from initial establishment of vegetation over 100 percent of the areas seeded.
- B. At the end of the warranty period, the Construction Manager will perform an inspection of the area. Seeded areas not demonstrating satisfactory condition of vegetation as specified in this Section, shall be repaired, reseeded, and maintained to meet requirements as specified in this Section at the Contractor's expense.

### **3.07 ACCEPTANCE**

- A. The vegetated areas shall be accepted at the end of the warranty period if a satisfactory condition exists as defined in this Section.
- B. After disturbed areas are stabilized and all necessary corrective work has been completed, the Construction Manager will certify in writing the final acceptance of the vegetated areas.

### **3.08 CONSTRUCTION QUALITY REQUIREMENTS**

- A. CQC Consultant will monitor vegetation and crusting agent application in accordance with this Section and Construction Quality Assurance (CQA) Plan.

TABLE 02930-1A

## SEED MIX IN DRY AREAS FOR PERMANENT VEGETATION

Species	Pounds Per Acre (lb/ac)
Big Bluestem	3
Little Bluestem	2
Side-Oats Grama	0.5
Indian Grass	2
Canada Wild-Rye	3
Switch grass	0.5
ReGreen	10
Wildflowers, uniform mix of the following:	1.5
Butterflyweed ( <i>Asclepias tuberosa</i> )	
New England Aster ( <i>Aster novae-angliae</i> )	
Smooth Aster ( <i>Aster laevis</i> )	
Canada Milkvetch ( <i>Astragalus Canadensis</i> )	
Purple Prairie Clover ( <i>Petalostemum purpureum</i> )	
Ox-eye Sunflower ( <i>Heliopsis helianthoides</i> )	
Bergamot ( <i>Monarda fistulosa</i> )	
Purple Coneflower ( <i>Echinacea purpurea</i> )	
Pale Purple Coneflower ( <i>Echinacea pallida</i> )	
Yellow Coneflower ( <i>Ratibida pinnata</i> )	
Black-Eyed Susan ( <i>Rudbeckia hirta</i> )	
Spiderwort ( <i>Tradescantia ohioensis</i> )	
Blue Vervain ( <i>Verbena hastata</i> )	
Hoary Vervain ( <i>Verbena stricta</i> )	
Beardtongue ( <i>Penstemon grandiflorus</i> )	
Cupplant ( <i>Silphium perfoliatum</i> )	
Sweet Joe Pye-Weed ( <i>Eupatorium purpureum</i> )	
White False Indigo ( <i>Baptisia leucantha</i> )	
Blue False Indigo ( <i>Baptisia australis</i> )	
Partridge Pea ( <i>Cassia fasciculata</i> )	
Rattlesnake Master ( <i>Eryngium yuccifolium</i> )	
Round-headed Bush Clover ( <i>Lespedea Capitata</i> )	
Stiff Goldenrod ( <i>Solidago risida</i> )	

TABLE 02930-1B

SEED MIX IN WET AREAS<sup>(1)</sup> FOR PERMANENT VEGETATION

Species	Pounds Per Acre (lb/ac)
Big Bluestem	3
Canada Wild-Rye	3
Switch Grass	0.5
Blue Joint Grass	0.5
Porcupine Sedge	1 ounce per acre (oz/ac)
Fox Sedge	1 ounce per acre (oz/ac)
Dark Green Bulrush	1 ounce per acre (oz/ac)
ReGreen	10
Prairie Cordgrass ( <i>Spartina pectinata</i> )	1
Wildflowers, uniform mix of the following:	1.5
Red Milkweed ( <i>Asclepias incarnata</i> )	
New England Aster ( <i>Aster novae-angliae</i> )	
Wild Senna ( <i>Cassia hebecarpa</i> )	
Canada Tick Trefoil ( <i>Desmodium canadense</i> )	
Prairie Blazingstar ( <i>Liatris pycnostachya</i> )	
Great Blue Lobelia ( <i>Lobelia siphilitica</i> )	
Bergamot ( <i>Monarda fistulosa</i> )	
Yellow Coneflower ( <i>Ratibida pinnata</i> )	
Branched Coneflower ( <i>Rudbeckia hirta</i> )	
Blue Vervain ( <i>Verbena hastata</i> )	
Angelica ( <i>Angelica atropurpurea</i> )	
Sweet Joe-Rye Weed ( <i>Eupatorium purpureum</i> )	

<sup>(1)</sup> Seeding in drainage ditches or swales shall contain erosion mats as specified in Section 02270 after application of seed mixture. Erosion mat shall cover a minimum width of 12 feet.

TABLE 02930-2

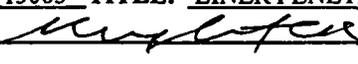
## SEED MIX FOR INTERIM VEGETATION

Species	Pounds Per Acre (lb/ac)
ReGreen	50
Annual Rye Grass	20
Canada Wild Rye	20

[END OF SECTION]

**SPECIFICATION COVER SHEET**

**SPECIFICATION SECTION:** 13005 **TITLE:** LINER PENETRATION BOXES

**Specifications By:** Signature  5 May 00  
 (Cognizant Engineer) Date  
Printed Name Michael J. Monteleone, P.E.  
and Title Senior Project Engineer

**Scope and Format**  
**Checked By:** Signature  5 May 00  
 (Checker) Date  
Printed Name Michael J. Monteleone, P.E.  
and Title Senior Project Engineer

**Detailed Requirements**  
**Checked by:** Signature  5 May 2000  
 (Checker) Date  
Printed Name Kwasi Badu-Tweneboah, PhD., P.E.  
and Title Senior Project Engineer

**Overall Review By:** Signature  8 May 2000  
 (PDP) Date  
Printed Name J.F. Beech, Ph.D., P.E.  
and Title Principal

**Approved by:** Signature  8 May 2000  
 (DTL) Date  
Printed Name J.F. Beech, Ph.D., P.E.  
and Title Principal

**Record of Revision (Number and initial all revisions)**

Rev. No.	Reason	Date	By	Checked	Approval
0	Certified for Construction	08 May 00		ISBT	JFB

**SECTION 13005****LINER PENETRATION BOXES****PART 1 GENERAL****1.01 SCOPE**

- A. This Section includes material, fabrication, and installation of liner penetration boxes.

**1.02 RELATED SECTIONS AND PLANS**

- A. Section 02100 - Surveying
- B. Section 02200 - Earthwork
- C. Section 02215 - Trenching and Backfilling
- D. Section 02225 - Compacted Clay Liner and Cap
- E. Section 02605 - High-Density Polyethylene (HDPE) Pipes and Fittings
- F. Section 02770 - Geomembrane Liner and Cap
- G. Construction Quality Assurance (CQA) Plan
- H. Part 8 - Environmental Health & Safety/Training Requirements
- I. Part 9 - Quality Assurance Requirements

**1.03 REFERENCES**

- A. Latest version of the American Society for Testing and Materials (ASTM) standards:
1. ASTM D 1248. Standard Specification for Polyethylene Plastics Molding and Extrusion Materials
  2. ASTM D 3212. Standard Specification for Joints for Drain and Sewer Plastic Pipe Using Flexible Elastomeric Seals.
  3. ASTM D 3350. Standard Specification for Polyethylene Plastics Pipe and Fittings Materials.
  4. ASTM F 1055. Standard Specification for Electrofusion Type Polyethylene Fittings for Outside Diameter Controlled Polyethylene Pipe and Tubing.

## 1.04 SUBMITTALS

- A. Submit to the Construction Manager for review the following liner penetration box fabrication details, together with Fabricator qualification and documentation of resins to be used, within 45 calendar days from Notice to Proceed:
1. Fabricator Qualifications:
    - a. name and qualifications of Fabricator of liner penetration boxes, including Fabricator quality control procedures;
    - b. a list of completed facilities for which the Fabricator has fabricated appurtenances from HDPE flat stock such as the liner penetration boxes; the list shall include the following information for each facility:
      - i. name, location, purpose of facility, and date of installation;
      - ii. names of owner, project manager, and design engineer; and
      - iii. description of special fabrication;
    - c. proposed fabrication dates for liner penetration boxes;
    - d. qualification procedure for Fabricator's welder(s); and
    - e. extrusion welding procedure for HDPE pipe, flat stock, and geomembrane liner.
  2. Documentation on the HDPE flat stock of the liner penetration boxes:
    - a. name of Manufacturer of HDPE flat stock used to fabricate liner penetration boxes; and
    - b. certification from the HDPE flat stock supplier that the HDPE flat stock meets the material requirements of this Section; certification shall include a statement that no reclaimed polymer is added to the resin during the manufacturing of the products to be used for this project.
  3. Two 6-inch by 6-inch by 1-inch thick samples of HDPE flat stock used in fabrication of the liner penetration boxes.
  4. Documentation on the HDPE pipe used in the fabrication of the liner penetration boxes in accordance with Section 02605.
  5. Liner penetration box fabrication:
    - a. detailed shop drawings of liner penetration boxes Type I, Type II, Type III, and Type IV, as shown on the Construction Drawings, showing:
      - i. box component dimensions;
      - ii. location of welds;
      - iii. weld types; and
      - iv. material tolerances;

- b. detailed design by liner penetration box Manufacturer for fabrication and installation of lifting hooks; design should be based on center gravity of liner penetration box; and
  - c. detailed handling and storing instructions.
6. Fabricator's quality assurance procedures including spark testing of geomembrane liner and pneumatic testing of the liner penetration boxes.
  7. Material Safety Data Sheet (MSDS) for HDPE products.
- B. Submit the following to the Construction Manager for review not less than 14 calendar days before liner penetration box shipment to the site:
1. results of Fabricator quality control tests required by this Section;
  2. written detailed installation procedures for the liner penetration boxes, including rigging for offloading and installation;
  3. written certification from the Fabricator that the materials and fabricated liner penetration boxes meet the requirements of this Section; and
  4. written certification from the Fabricator that welders are qualified to perform extrusion welding specified in this Section.
- C. Provide list of equipment, description of construction methods, and other required information related to installation of liner penetration boxes in the Contractor's Earthwork Work Plan specified in Section 02200.

## **1.05 HEALTH AND SAFETY REQUIREMENTS**

- A. Environmental health & safety/training requirements shall be in accordance with Part 8 of the Contract Documents.

## **1.06 CONTRACTOR'S QUALITY ASSURANCE**

- A. Contractor's quality assurance requirements shall be in accordance with Part 9 of the Contract Documents.

## **PART 2 PRODUCTS**

### **2.01 HDPE FLAT STOCK**

- A. Furnish 1-inch thick HDPE flat stock manufactured from new, high performance, high molecular weight, HDPE resin conforming to ASTM D 1248 (Type III, Class C Category 5, Grade P 34), ASTM D 3350 (Cell Classification PE 345434C), and having a Plastic Pipe Institute (PPI) Rating of PE 3408. The resin shall be pre-compounded.

In-plant blending of non-compounded resins is not permitted. Furnish material having minimum specified property values listed in Table 13005-1.

- B. Furnish only smooth HDPE flat stock with no sharp projections, homogeneous throughout with respect to resin compound, and with surfaces free of foreign inclusions and surface defects. Furnish HDPE flat stock that is as uniform as commercially practical in color, opacity, density, and other physical properties.

## **2.02 HDPE GEOMEMBRANE SKIRT**

- A. Fluor Fernald, Inc. will furnish 80-mil thick HDPE geomembrane meeting the requirements of Section 02770, with minimum dimensions of 7 feet by 7 feet, required for the HDPE skirt shown on the Construction Drawings.

## **2.03 HDPE PIPE**

- A. Furnish HDPE pipe in accordance with Section 02605.
- B. Fabricate pipe outlets as shown on the Construction Drawings.

## **2.04 LINER PENETRATION BOXES**

- A. Fabricate liner penetration boxes to the dimensions shown on the Construction Drawings and tolerances specified in this Section.
- B. Fabricate liner penetration box outlets from HDPE pipe. Do not use flat stock. HDPE pipe outlets shall meet the requirements shown on the Construction Drawings.
- C. Weld liner penetration box components in accordance with the recommended HDPE welding procedures by the Fabricator and approved by the Construction Manager. Weld HDPE geomembrane skirt to liner penetration boxes using extrusion welding method and perform spark testing specified in this Section.
- D. Furnish one 3/8-inch National Pipe Thread (NPT) air pressure test port for each box.
- E. Liner penetration boxes shall be furnished with lifting hooks as required by the Fabricator.

## **2.05 EQUIPMENT**

- A. Provide equipment to install and test liner penetration boxes in accordance with the requirements of this Section.

**2.06 FABRICATOR QUALITY CONTROL**

- A. Conduct welder prequalification test each day before production welding in accordance with the submittal procedure specified in this Section. Archive test specimens for 90 calendar days from date of shipment.
- B. Pressure test each completed liner penetration box prior to shipping. Perform pressure test in accordance with ASTM D 3212, except that the air pressure shall be maintained for a testing period of 30 minutes and at an air pressure of 10.8 pounds per square inch (psi) applied through the air pressure ports. Monitor the air pressure and apply soapy solution to all welds to facilitate detection of leaks. Measured air pressure shall remain constant over the testing period except for changes which can be explained due to material relaxation and expansion. Grind out any leaking seams and reweld. Repeat test. Reject any box with a pressure loss in which the leak cannot be found and repaired. Test gauges shall be calibrated within one year of date of test. Calibration shall be traceable to national or industry recognized standards where possible.
- C. Permit the CQC Consultant and/or a Fluor Fernald, Inc. representative to visit the fabrication plant for project specific visits. If possible, such visits will be prior to, or during, the fabrication and/or Fabricator quality control testing of the liner penetration boxes.

**2.07 BENTONITE**

- A. Furnish bentonite granules conforming to the requirements of Section 02225.
- B. Prepare soil-bentonite mix in accordance with Section 02225.

**PART 3 EXECUTION****3.01 EXCAVATION**

- A. Do not commence installation of liner penetration boxes until the CQC Consultant completes performance testing and confirmation of compliance of underlying layers, including acceptance of Contractor's survey results for underlying layers.
- B. Notify the Construction Manager a minimum of 2 working days prior to the start of liner penetration box installation.
- C. Excavate compacted clay liner and granular drainage material to the lines and grades shown on the Construction Drawings for placement of liner penetration boxes.

Minimize overexcavation and disturbance of the compacted clay liner and granular drainage material.

- D. Perform excavation in accordance with Section 02200.
- E. Dewater excavation in accordance with the requirements of Section 02200.

### **3.02 BOX INSTALLATION**

- A. Hand grade compacted clay liner surface and granular drainage material surface under the foot print of the box on which liner penetration box is to be installed. Make surface smooth to obtain close contact between compacted clay liner and liner penetration box. Recompact material in accordance with Section 02225 and regrade if contact occurs between the bottom of the box and the compacted clay liner surface.
- B. Apply bentonite granules at a rate of 1 lb/ft<sup>2</sup> over the compacted clay liner under the footprint of the box.
- C. Install the liner penetration boxes at the locations and elevation shown on the Construction Drawings.
- D. Join the sections of pipe between liner penetration boxes and Enhanced Permanent Leachate Transmission System Valve Houses using butt-fusion welding as specified in Section 02605.
- E. Backfill around LCS, redundant LCS, and LDS pipes in accordance with Sections 02215 and 02225 using soil-bentonite mix.
- F. Backfill around liner penetration boxes using soil-bentonite mixture and compact in accordance with the requirements of Section 02225. Fill any interface between the compacted clay liner and liner penetration box with bentonite granules.
- G. Air pressure test liner penetration boxes in accordance with the requirements of this Section. Air pressure testing shall be conducted after the backfill around the penetration boxes is completed. Testing equipment shall be equipped with a regulator capable of limiting supply pressure to 15 psi.
- H. Install 1.25 inch diameter bentonite fill holes at locations shown on the Construction Drawings and fill chamber of each liner penetration box with bentonite granules. After bentonite filling is complete, seal each hole with HDPE extrudate placed with extrusion welding equipment as specified in Section 02770.

- I. Weld geomembrane to each liner penetration box skirt as soon as air pressure testing, surveying, and bentonite filling are complete. Welding shall be by the extrusion method and shall be non-destructively tested as specified in Section 02770.

### **3.03 AIR PRESSURE TEST**

- A. Air pressure test each liner penetration box after associated earthwork and compacted clay liner placement is complete and prior to geosynthetics installation over the boxes. Use the air pressure testing procedure specified in this Section. Conduct the pressure test in the presence of the CQC Consultant. Test gauges shall be calibrated within one year of use. Calibration shall be traceable to national or industry recognized standards where possible.
- B. In the event an unexplainable pressure loss occurs, excavate the liner penetration box and investigate for leaks and perform necessary repairs. Replace any liner penetration box that has a pressure leak if the leak cannot be found and repaired.
- C. The Fabricator shall make repairs to the liner penetration box.
- D. HDPE geomembrane skirt extrusion weld shall be vacuum tested in accordance with Section 02770 after associated earthwork and compacted clay liner placement is complete.
- E. Seal test openings with HDPE extrudate placed with extrusion welding equipment as specified in Section 02770.

### **3.04 CONSTRUCTION QUALITY REQUIREMENTS**

- A. CQC Consultant will monitor installation of liner penetration boxes in accordance with this Section and the Construction Quality Assurance (CQA) Plan.
- B. CQC Consultant will monitor air pressure testing of liner penetration boxes to confirm and document compliance with this Section.

### **3.05 SURVEY CONTROL**

- A. Survey the locations and elevations of the liner penetration boxes in accordance with Section 02100 and as indicated on the Construction Drawings.

### 3.06 TOLERANCES

- A. Tolerances shall be 0.1 feet vertical and 0.5 feet horizontal for any dimension shown on the Construction Drawings for the liner penetration boxes.

TABLE 13005-1

**REQUIRED HDPE FLAT STOCK PROPERTIES  
ASTM D 3350 CELL CLASSIFICATION PROPERTIES AND RANGES**

Properties	Cell Classification	Qualifiers	Units <sup>1</sup>	Specified Property Values	Test Method
Density	3	Minimum	g/cm <sup>3</sup>	0.94	ASTM D 1505
Melt Flow Index	3 to 5	Maximum	g/10 min	<0.4	ASTM D 1238 (Condition E)
Flexural Modulus	5	Minimum	lb/in <sup>2</sup>	110,000	ASTM D 790
Tensile Strength	4 or 5	Minimum	lb/in <sup>2</sup>	3,000	ASTM D 638
Environmental Stress Crack	3	Minimum	hrs	F <sub>20</sub> > 192	ASTM D 1693
Hydrostatic Design Basis at 73°F	4	Minimum	lb/in <sup>2</sup>	1,600	ASTM D 2837
UV Stabilizer	C	Minimum	% Carbon Black	2	ASTM D 1603

## Notes:

- 1.
- |                    |   |                            |
|--------------------|---|----------------------------|
| g/cm <sup>3</sup>  | = | grams per cubic centimeter |
| g/10 min           | = | grams per 10-minutes       |
| lb/in <sup>2</sup> | = | pounds per square inch     |
| hrs                | = | hours                      |

[END OF SECTION]

**SECTION 13000****BORROW AREA MANAGEMENT****PART 1 GENERAL****1.01 SCOPE**

- A. This Section includes requirement for borrow area management and interim restoration.

**1.02 RELATED SECTIONS AND PLANS**

- A. Section 02100 - Surveying
- B. Section 02110 - Clearing, Grubbing, and Stripping
- C. Section 02150 - Traffic Control
- D. Section 02200 - Earthwork
- E. Section 02215 - Trenching and Backfilling
- F. Section 02225 - Compacted Clay Liner and Cap
- G. Section 02230 - Road Construction
- H. Section 02240 - Non-Impacted Protective and Contouring Layers
- I. Section 02270 - Surface-Water Management and Erosion Control
- J. Section 02714 - Geotextiles
- K. Section 02721 - Culverts
- L. Section 02920 - Topsoil
- M. Section 02930 - Vegetation
- N. Construction Quality Assurance (CQA) Plan
- O. Borrow Area Management and Restoration (BAMR) Plan

- P. Part 6 - Statement of Work
- Q. Part 8 - Environmental Health & Safety/Training Requirements
- R. Part 9 - Quality Assurance Requirements

### 1.03 REFERENCES

- A. Latest version of Ohio Department of Transportation Construction and Material Specifications (Ohio DOT Specifications).
- B. Latest version of Ohio Department of Natural Resources (ODNR) Rainwater and Land Development Standards (ODNR Rainwater and Land Development Standards).

### 1.04 SUBMITTALS

- A. Submit to the Construction Manager for review a Contractor's Borrow Area Management and Restoration Work Plan within 30 calendar days from Notice to Proceed. The Contractor's Borrow Area Management and Restoration Work Plan shall be prepared in accordance with this Section and the Borrow Area Management and Restoration (BAMR) Plan and include, but not be limited to, the following:
  - 1. An overall phasing and sequencing plan for development of subareas of the borrow area and a detailed excavation and interim restoration plan for each subarea.
  - 2. Borrow area excavation plan showing excavation limits including excavation elevations and side slopes for subarea to be excavated in one construction season. Excavation elevation for subarea to be excavated shall be as shown on the Construction Drawings.
  - 3. Interim restoration plan for the subarea to be excavated in one construction season. Interim restoration requirements shall be as shown on the Construction Drawings.
  - 4. Borrow area haul roads from borrow subareas to On-Site Disposal Facility (OSDF) construction location, material stockpile areas, and roads within the active borrow subarea.
  - 5. Stockpiling plan for materials from clearing and grubbing, stripping, non-conforming clay liner and cap material, ordinary borrow material, screened clay material, and clayey rockfill material, including stabilization and maintenance of stockpiles as shown on the Construction Drawings, and in accordance with Sections 02200 and 02930.

6. Surface-water management and erosion control plan and details for the borrow subareas to be excavated, interim restoration, borrow area haul roads, and stockpiles in accordance with Section 02270.
  7. List of equipment and description of construction methods for borrow area management and interim restoration.
  8. Coordination plan for providing equipment and labor for the pre-conformance and conformance testing of soils from the borrow source in accordance with Section 02225 and Construction Quality Assurance (CQA) Plan.
  9. Construction schedule for the BAMR construction and maintenance activities and duration for each BAMR activity.
  10. Plan for maintenance of borrow area surface-water management and erosion control measure and Borrow Area Sedimentation Basin in accordance with Section 02270.
- B. In accordance with Section 02150 and Part 6 of the Contract Documents, include location of borrow area haul roads, construction accesses, road crossings, and proposed methods and equipment for borrow area haul road crossings in the Contractor's Traffic Control Plan.
- C. Submit to the Construction Manager, a Plan showing surveyed information for excavation limits and elevations, extension of subarea into the adjacent subarea, if any, stockpile locations, drainage ditches and berms, and gray till elevation if encountered during excavation within 15 calendar days from the completion of borrow subarea excavation.

#### **1.05 HEALTH AND SAFETY REQUIREMENTS**

- A. Environmental, health & safety/training requirements shall be in accordance with Part 8 of the Contract Documents.

#### **1.06 CONTRACTOR'S QUALITY ASSURANCE**

- A. Contractor's quality assurance shall be in accordance with Part 9 of the Contract Documents.

### **PART 2 PRODUCTS**

#### **2.01 MATERIALS**

- A. Clay liner and cap material shall meet the requirements of Section 02225.

- B. Ordinary borrow material, which includes materials for compacted fill, trench backfill, non-impacted protective and contouring layers, and vegetative soil layer, shall meet the material requirements of Sections 02200, 02215, 02240, and 02250, respectively
- C. Topsoil material shall meet the requirements of Section 02920.
- D. Roadway base material, and geotextile separator, shall meet the requirements of Sections 02230 and 02714, respectively.
- E. Corrugated metal pipe (CMP) culverts shall meet the requirements of Section 02721.

## **2.02 EQUIPMENT**

- A. Furnish equipment to manage and restore the borrow area.

## **PART 3 EXECUTION**

### **3.01 GENERAL**

- A. Perform borrow area management in accordance with this Section, the Construction Drawings, and the Contractor's Borrow Area Management and Restoration Work Plan.
- B. Dust control shall be in accordance with Part 6 of the Contract Documents.

### **3.02 BORROW AREA MANAGEMENT**

- A. Assist the CQC Consultant in obtaining soil samples for pre-conformance and conformance testing.
- B. Stake the limits of excavation for the borrow subarea and stockpiles as shown on the Construction Drawings and in accordance with Section 02100.
- C. Install and maintain construction safety fence around borrow subarea and stockpiles as shown on the Construction Drawings and in accordance with Section 02200.
- D. Install and maintain surface-water management and erosion control measures in accordance with the Construction Drawings, Section 02270, and Contractor's Surface-Water and Erosion Control Work Plan.
- E. Install surface-water management and erosion control measures before initiating land disturbing activity in borrow subarea or stockpile area.

- F. Excavate the borrow area to provide positive drainage into Borrow Area Sedimentation Basin.
- G. Perform clearing, grubbing, and stripping in accordance with Section 02110.
- H. Construct and maintain borrow area haul roads in accordance with this Section 02230, and as shown on the Construction Drawings.
- I. Remove existing stockpiles from the subarea and relocate this material to the location approved by the Construction Manager.
- J. Perform borrow subarea excavation after completion of the following activities:
  - 1. pre-conformance testing and written confirmation of pre-conformance of material by CQC Consultant; and
  - 2. written authorization by the Construction Manager.
- K. Set up the mechanical screening plant in accordance with Section 02225 active within the active borrow subarea, or the screened material Stockpile Area shown on the Construction Drawing, or as approved by the Construction Manager.
- L. Excavate borrow materials and segregate pre-conforming soils from non-conforming soils based on pre-conformance testing results. The Construction Manager will provide Contractor with results of pre-conformance testing specified in this Section. Excavate exterior side slopes of borrow area boundary to 6 horizontal to 1 vertical (6H:1V) and interior side slopes 3H:1V or flatter.
- M. Stockpile excavated ordinary borrow material including nonconformance soil at stockpile area indicated on the Construction Drawings. Clayey rockfill shall be stockpiled in stockpile area indicated on the Construction Drawings, or as directed by the Construction Manager. Stabilize stockpiles in accordance with Section 02930.
- N. Screen pre-conforming soils for clay liner and cap material in accordance with Section 02225. Stockpile and label clay liner and cap material stockpile in accordance with Section 02225. Stabilize clay liner and cap material stockpile with crusting agent in accordance with Section 02930.
- O. Contractor shall relocate mechanical screening plant within the borrow subarea or stockpile area, as required, to complete excavation in the borrow subarea. Relocation of the screening plant shall be as approved by the Construction Manager.
- P. Excavate the borrow subarea to final excavation elevations shown on the Construction Drawings and as specified in this Section.

- Q. Remove remaining stockpiles from the borrow subareas, except for clayey rockfill stockpile, as directed by Construction Manager. Use clayey rockfill for interim restoration of the borrow subarea.
- R. Perform interim restoration in the borrow subarea as specified in this Section.

### **3.03 INTERIM RESTORATION**

- A. Perform interim restoration of borrow subarea as shown on the Construction Drawings and in accordance with the Contractor's Borrow Area Management and Restoration Work Plan.
- B. Stabilize and vegetate borrow subareas in accordance with Section 02930.

### **3.04 TRAFFIC CONTROLS**

- A. Traffic controls shall be in accordance with Section 02150 and Contractor's Traffic Control Plan.

### **3.05 BORROW AREA HAUL ROAD**

- A. Install surface-water management and erosion control measures in accordance with Contractor's Borrow Area Management and Restoration Work Plan.
- B. Locate and install culverts associated with the borrow area haul road in accordance with Section 02721 and Contractor's Borrow Area Management and Restoration Work Plan. Select and install culverts so that surface-water is not impounded by the borrow area haul roads.
- C. Road construction shall be in accordance with Section 02230.
- D. Place geotextile separator under base aggregate for the haul road directly on a ground surface after stripping of topsoil from road area.
- E. Maintain base aggregate in such a manner that the haul equipment tires are isolated from the uncertified area shown on the Construction Drawings.
- F. Maintain the borrow area haul road from the borrow area to OSDF construction location(s) as shown on the Construction Drawings and in accordance Contractor's Borrow Area Management and Restoration Work Plan.

**SECTION 13010****IMPACTED MATERIALS PLACEMENT****PART 1 GENERAL****1.01 SCOPE**

- A. This Section includes requirements for the impacted materials placement in the On-Site Disposal Facility (OSDF), and materials and installation for the support facilities required for the impacted materials placement. Support facilities include, but are not limited to, surface-water management and erosion controls, OSDF Material Transfer Area (OMTA), Impacted Material Haul Roads, access control facility, equipment wash facility, wheel wash facility, and traffic controls.
- B. Impacted material quantities to be placed in the OSDF shall be as specified in Part 6 of the Contract Documents.

**1.02 RELATED SECTIONS AND PLANS**

- A. Section 02100 - Surveying
- B. Section 02150 - Traffic Control
- C. Section 02200 - Earthwork
- D. Section 02240 - Non-Impacted Protective and Contouring Layers
- E. Section 02270 - Surface-Water Management and Erosion Control
- F. Section 02930 - Vegetation
- G. Impacted Materials Placement (IMP) Plan
- H. Waste Acceptance Criteria (WAC) Attainment Plan
- I. Part 6 - Statement of Work
- J. Part 8 - Environmental Health & Safety/Training Requirements
- K. Part 9 - Quality Assurance Requirements

### 1.03 REFERENCES

- A. *"Identification and Listing of Hazardous Waste"*, Title 40, Code of Federal Regulations (CFR), Part 261, Subpart E.C.

### 1.04 SUBMITTALS

- A. Submit to the Construction Manager for review within 30 calendar days from Notice to Proceed a Contractor's Impacted Materials Placement Work Plan that meets the requirements of the Impacted Materials Placement (IMP) Plan specified in this Section. Contractor's Impacted Materials Placement Work Plan shall include, at a minimum:
1. methods for managing impacted runoff during impacted materials and non-impacted contouring layer placement;
  2. inspections, repairs, and maintenance of surface-water management and erosion control measures and impacted runoff catchment areas;
  3. dust control plan including methods and equipment for the dust control within the OSDF, at OMTA, and Impacted Material Haul Roads;
  4. Contractor's system interface with Waste Acceptance Organization (WAO) of Fluor Fernald, Inc. prior to acceptance of impacted material at the OSDF battery limit;
  5. impacted materials placement requirements, including placement methods, equipment and manpower for stockpiling, staging, placing, spreading, grading, compacting and controlling lift thickness for the following layers:
    - a. impacted protective layer;
    - b. select impacted material layers;
    - c. Category 1 impacted material layers; and
    - d. Category 2, 3, 4, and 5 materials layers;
  6. methods for managing and temporarily stockpiling impacted materials within the OSDF cells;
  7. methods and equipment for impacted materials placement during:
    - a. inclement weather operations;
    - b. placing, spreading, grading, and compacting;
    - c. maintenance of surface conditions and drainage; and
    - d. installation and maintenance of surface-water management and erosion control measures;
  8. Contractor's quality assurance activities for the impacted materials placement;
  9. Wheel wash facility:
    - a. plan and details showing:
      - i. layout of the wash facility, utilities, wash water tie-in, and access roads;

- ii. plan, sections, and details for the concrete pad, trenches, pits, and utility tie ins; and
  - iii. plans and details for collection, sedimentation method, and discharge of wash water;
  - b. shop drawings for equipment;
  - c. methods and equipment for wheel washing during impacted materials placement; and
  - d. calculations to support the concrete pad design and design life of the wheel wash facility;
10. phased plans and cross-sections showing progressive impacted materials placement in the OSDF; plans and cross-section shall show the following:
- a. grading plan, drainage, surface-water management and erosion controls, grid markers, limits of the impacted materials, and access ramp locations at:
    - i. beginning of construction season;
    - ii. mid-season progress; and
    - iii. end of the construction season;
  - b. impacted materials placement plan for filling the impacted runoff catchment areas, placing over intercell berms, and filling drainage ditches at intercell berms;
  - c. access ramp plan and details including:
    - i. alignment;
    - ii. maximum slope;
    - iii. minimum curve radius;
    - iv. elevations;
    - v. typical ramp cross section;
    - vi. side slopes;
    - vii. road width;
    - viii. surfacing material; and
    - ix. safety berms;
  - d. drainage plan with culverts (type, length, slope, size); and
  - e. cross-sections showing limits and elevation of the impacted materials in each cell at:
    - i. beginning of the construction season;
    - ii. mid-season progress; and
    - iii. end of the construction season;
11. sources for protective and select impacted material layers; and
12. survey methods for the following:
- a. locating grid and lift;
  - b. elevations;

- c. change in category of material; and
  - d. survey frequency.
- B. Submit to the Construction Manager for review the impacted materials placement location plan on a weekly basis. The plan shall be submitted at least 3 calendar days prior to weekly placement. The plan shall include, but is not limited to:
- 1. date of projected placement;
  - 2. anticipated sources of impacted material;
  - 3. category, type, and estimated truck or roll-off box count;
  - 4. identified grids to be used for the week's placement.

### **1.05 HEALTH AND SAFETY REQUIREMENTS**

- A. Environmental health & safety/training requirements shall be in accordance with Part 8 of the Contract Documents.

### **1.06 CONTRACTOR'S QUALITY ASSURANCE**

- A. Contractor's quality assurance requirements shall be in accordance with Part 9 of the Contract Documents.

## **PART 2 PRODUCTS**

### **2.01 MATERIALS**

- A. Materials for impacted protective layer and select impacted layers shall be as specified in the IMP Plan. Contractor shall identify impacted material sources for the impacted protective layer and select impacted material layers from the impacted material excavation areas as approved by the Construction Manager.
- B. Materials for Category 1, 2, 3, 4, and 5 impacted materials layers shall be as specified in the IMP Plan. Sources and quantity of Category 1, 2, 3, 4, and 5 impacted materials shall be as specified in Part 6 of the Contract Documents.
- C. The following impacted materials are not included in the sources specified in Part 6 of the Contract Documents, but are anticipated during construction of and placement of materials in the OSDF. These materials include: asphaltic concrete, petroleum spill cleanups, oil filters, personal protective equipment (PPE), bagged oily rags/absorbent, wooden pallets, bagged control point waste, and sediment from ditches and basins.

Disposition and placement of these impacted materials in the OSDF shall be as approved by the Construction Manager.

- D. Crusting agent for dust control and stabilization shall be in accordance with the requirements specified in Section 02930.
- E. Grid marker signs for the OSDF cell grid identification will be furnished by Fluor Fernald, Inc. Contractor shall furnish posts or support frames, minimum 8 feet in height, and fasteners for installation of the grid marker signs.
- F. Furnish windsocks and frames as specified below:
  - 1. windsock shall be orange in color, manufactured with PVC over nylon, double sewn seams with brass grommets;
  - 2. windsock shall be minimum 18 inch diameter and minimum 48 inch length;
  - 3. frame for the windsock shall be aluminum on a standard 1.25 inch pipe with NPT threads; and
  - 4. pipe for mounting windsock frame shall be 1.25 inch diameter galvanized pipe, standard schedule, and minimum 15-foot length with NPT threads.
- G. Provide radiological control fence as specified in Section 02200.

## 2.02 EQUIPMENT

- A. Provide equipment for impacted materials placement, including spreading, grading, and compaction, in accordance with the Contractor's Impacted Materials Placement Work Plan.
- B. Provide equipment and tractor trailer flatbed and roll-off trucks for loading and hauling impacted materials from the OMTA and other transfer areas specified in Part 6 of the Contract Documents.
- C. Provide equipment for stockpiling Category 1 impacted materials and staging Category 2 impacted materials in the OSDF.
- D. Provide sump pump(s), hoses, and supporting equipment and tools required to discharge and control impacted runoff at the impacted runoff catchment area, OMTA, and Impacted Material Haul Roads.
- E. Provide materials and equipment for dust control in the OSDF cells, at OMTA, and on Impacted Material Haul Roads in accordance with Part 6 of the Contract Documents.

## 2.03 WHEEL WASH FACILITY

### A. Utilities provided by Fluor Fernald, Inc.:

1. Construction water for the wheel wash shall be obtained from Construction Water Wells #1 and #2 or Well Houses #1 and #2 as shown on the Construction Drawings. Approximately 50 gallons per minute (gpm) construction water supply will be provided at each of the construction water source specified in this Section.
2. A 480-Volts, 3-Phase, 60-Hertz electric power will be provided at Valve House No. 4.

### B. Material, equipment, and wheel wash facility shall meet the following performance criteria:

1. Wheel wash facility shall have minimum 5-year design life.
2. Wheel wash facility shall be located approximately 100 feet west of Fernald Environmental Management Project (FEMP) security fence in the radiologically controlled area along the existing Impacted Material Haul Road. Final location will be determined by the Construction Manager.
3. Wheel wash facility shall be designed and constructed to wash wheels, tires, under carriage, and outside body of a fully loaded Caterpillar D 300E articulated truck or equivalent and Ford LT9513 roll-off truck or equivalent. The wheel wash facility shall also be designed to wash tractor-trailer flat bed trucks. Approximately 50 trucks per day may be washed at this facility.
4. Wheel wash facility shall be designed and constructed to include:
  - a. asphaltic concrete access roads connecting the existing Impacted Material Haul Road to and from the wheel wash facility;
  - b. reinforced concrete entrance ramp with curbs, 15 feet wide and 20 feet in length, at the wheel wash facility entrance;
  - c. reinforced concrete wash pad with curbs, 15 feet wide and 30 feet in length, between entrance ramp and exit ramp;
  - d. reinforced concrete exit ramp with curbs, 15 feet wide and 20 feet in length, at the wheel wash facility exit;
  - e. reinforced concrete trench system or similar system to collect sediments and wash water from the entrance and exit ramps, wash pad, splash wall or curtain, and adjacent areas;
  - f. reinforced concrete ramps, pad, trench or similar sediment and wash water collection system, and underground utilities shall support the fully loaded Caterpillar D 300 or equivalent truck;
  - g. concrete surfaces shall be roughened or textured finish;
  - h. splash wall or curtain at both sides of the wash area to contain wash water spray within the wash area meeting the following requirements:
    - i. withstand 60 miles per hour (mph) wind;

- ii. continuous with no opening;
  - iii. water repellent;
  - iv. ultraviolet (UV) light protected;
  - v. resistant to rotting and rusting;
  - vi. at least 8 ft high above the washing surface;
  - vii. direct wash water to the wash area; and
  - viii. contain spray water within the wash areas;
- i. the automated wheel wash system to wash wheels, tires, undercarriage, and outside body of truck or equipment for removal of visible mud, dirt, and debris before leaving the wash area; this system shall spray water directly and continuously into the threads of tires for at least two full tire revolution of Caterpillar D 300E articulated truck, Ford LT9513 roll-off truck, or equivalent, and tractor trailer flat bed truck driven through the wash area as the trucks are positioned directly over trench system; the water spray system shall be accessible for maintenance;
  - j. a self-activated switching system with manual and emergency override system to start and stop automated wheel wash system when vehicle passes through the wash area;
  - k. the wash pad shall contain an area for manual wash operations;
  - l. freeze protection and a system to facilitate purging of the wheel wash system in preparation for system shutdown;
  - m. wash water collected from the wash area shall be retained to reduce the sediment load prior to discharging into the FEMP former production area storm drainage system; the collection system shall minimize sediment build-up on the bottom of the system shall and promote collection of sediment to a location outside the wash pad area for periodic removal;
  - n. wash water collection system shall be designed to drain to existing storm drainage system;
  - o. a minimum of two removable type rumble strips at the exit ramp to provide an interrupted broken surface for purpose of shaking excess water off truck or equipment; strips shall support the truck and equipment load and movement;
  - p. signs and sign posts at the wheel wash facility for identification of the facility entrance, and exit; and
  - q. water storage tank at the wheel wash facility to store water required for washing 50 trucks.
- C. **Material and Equipment:** Provide material and equipment including required accessories to meet the performance criteria for wheel wash facility specified in this Section. Material and equipment for wheel wash facility shall include but not be limited to:

1. Pumps and pipeline for delivering water from water source, shown on the Construction Drawings, to the water storage tank(s) at wheel wash facility. Provide valves to isolate water line from the water source and storage tank(s).
2. Water meter at water source for recording daily water volume, in gallons per day, delivered to the wheel wash facility.
3. Water storage tank(s) with water level indicator and overflow pipe.
4. Pumps and pipeline to deliver water to the automated spray wash system and manual wash system.
5. Manual wash system with hand held nozzles on each side of wash pad area.
6. Automated spray wash system with nozzles.
7. Control system for automated spray wash system including self-activated switching system.
8. Floor drain, grating, and other piping and valves required to collect and discharge wash water.
9. Guard posts at the end of entrance and exit ramps.
10. Electrical system including transformer switches, motors, grounding, and accessories required for operation of the wheel wash facility.
11. Splash wall or curtain along both sides of wash area.

## **PART 3 EXECUTION**

### **3.01 GENERAL**

- A. Install radiological control fence in accordance with Part 8 of the Contract Documents.
- B. Perform construction activities in such a manner that equipment operating in the radiologically-controlled areas (RCAs) do not operate in non-RCAs. Equipment operating in RCAs shall be washed and radiologically surveyed and released by Fluor Fernald, Inc. prior to exiting for use in non-RCAs.
- C. Radiological access control facility, as shown on the Construction Drawings, will be installed and maintained by Fluor Fernald, Inc.
- D. Install windsocks at location directed by the Construction Manager. Windsocks shall be located at the highest elevation in each cell and no closer than 100 feet from the wheel wash facility splash walls.
- E. Air monitors at OSDF will be installed and maintained by Fluor Fernald, Inc.

- F. Place grid marker signs with posts or support frames at 100-ft intervals outside the active impacted material placement along the OSDF perimeter berms. Anchor support frames with sandbags. Support frame shall not penetrate through the cell liner system. Inspect and maintain grid markers on weekly basis and after significant storm events.
- G. Perform impacted runoff management in accordance with this Section, Section 02270, the Construction Drawings, IMP Plan, and Part 6 of the Contract Documents.
- H. Equipment fueling and routine maintenance shall not be conducted in an active cell of the OSDF. Fueling locations will be approved by Fluor Fernald, Inc.
- I. Dust control shall be in accordance with Part 6 of the Contract Documents.
- J. Category 2 through 5 impacted materials shall be covered by Category 1 material in accordance with the IMP Plan, and prior to winter shutdown.
- K. Surface of impacted materials in the OSDF cells shall be stabilized with suitable surface protection at winter shutdown in accordance with IMP Plan and Section 02930.
- L. Traffic control shall be in accordance with the Contractor's Traffic Control Plan specified in Section 02150.
- M. Construct and maintain Impacted Material Haul Roads, access ramps, and ramps within cells shown on the Construction Drawings and as specified in this Section.
- N. OMTA and other transfer area, unless shown on Construction Drawings, will be constructed by Fluor Fernald, Inc. Maintain OMTA and other impacted material transfer areas shown on the Construction Drawings and specified in Part 6 of the Contract Documents.

### **3.02 SURFACE-WATER MANAGEMENT AND EROSION CONTROL**

- A. Install and maintain surface-water management and erosion control measures in accordance with Section 02270 and Contractor's Impacted Materials Placement Work Plan.
- B. Manage impacted runoff in each OSDF cell, Impacted Material Haul Roads, and OMTA during Contract period in accordance with the Contractor's Impacted Materials Placement Work Plan, Contractor's Surface-Water Management and Erosion Control Work Plan specified in Section 02270, and Part 6 of the Contract Documents.

- C. Maintain the impacted runoff catchment area to minimize sediment deposits. Sediments shall not clog or impede impacted stormwater flow into the leachate collection system (LCS). Depth of sedimentation shall not exceed 6 inches in the impacted runoff catchment areas. Sediment build-up exceeding 6 inches shall be excavated and placed in an area of the cell outside the catchment area. Inspection and repair of the impacted runoff catchment area shall be in accordance with the Contractor's Impacted Materials Placement Work Plan.
- D. Direct impacted and non-impacted runoff from impacted material and the contouring layer to the impacted runoff catchment area of the adjacent downgradient cell in accordance with Section 02240.

### **3.03 PLACEMENT AND COMPACTION**

- A. Do not place impacted material until WAO of Fluor Fernald, Inc. approves the impacted material manifests at the OSDF battery limit.
- B. Place impacted material layer after the CQC Consultant has completed performance testing and confirmation of compliance of underlying layers, including acceptance of the Contractor's survey results of underlying layers.
- C. Place and compact impacted materials in the OSDF in accordance with the IMP Plan.

### **3.04 WHEEL WASH FACILITY**

- A. Wheel wash facility location along the existing Impacted Material Haul Road shall be adjusted in the field as approved by the Construction Manager.
- B. Wheels, tires, undercarriage, and outside body of equipment or truck shall be washed in accordance with Part 8 of the Contract Documents.
- C. Grating, concrete pad surface, and washing surfaces that come in direct contact with vehicle tires shall be kept clean to minimize recontamination of tires.
- D. Wash water collected from the pad shall be retained to reduce sediment load prior to being discharged into the FEMP Stormwater Management System.
- E. Wheel wash shall be performed within wash pad area. Water overspray shall be controlled and confined to wash pad area.
- F. Keep Impacted Material Haul Road and wheel wash free of mud, dirt, and debris.

- G. Maintain utilities from the tie-in location to wheel wash facility.

### **3.05 EQUIPMENT WASH FACILITY**

- A. Equipment used for loading, hauling, unloading, stockpiling, staging, placing, compacting, dust control, and other activities related to the impacted materials placement shall not leave the RCAs until equipment washing activities are completed by the Contractor at the equipment wash facility. After washing, equipment shall be radiologically surveyed and released by Fluor Fernald, Inc.
- B. Gross washing of equipment shall be as specified in Part 8 of the Contract Documents.

### **3.06 CONSTRUCTION QUALITY REQUIREMENTS**

- A. CQC Consultant will perform conformance testing of impacted materials for placement in accordance with the Impacted Materials Placement Quality Assurance Plan.
- B. CQC Consultant will monitor impacted materials placement in the OSDF in accordance with this Section, the IMP Plan, and the Impacted Materials Placement Quality Assurance Plan.
- C. CQC Consultant will perform performance testing of impacted materials placement in accordance with the Impacted Materials Placement Quality Assurance Plan.

### **3.07 SURVEY CONTROL**

- A. Survey the locations, limits, and grades of the impacted material layers in accordance with Section 02100.

### **3.08 TOLERANCES**

- A. Construct the impacted protective layer to within 0.0 to +0.1 feet of the thickness shown on the Construction Drawings.
- B. Construct the select impacted material layer for the liner system and the final cover system to within 0.0 to +0.1 feet of the thickness shown on the Construction Drawings.

[END OF SECTION]